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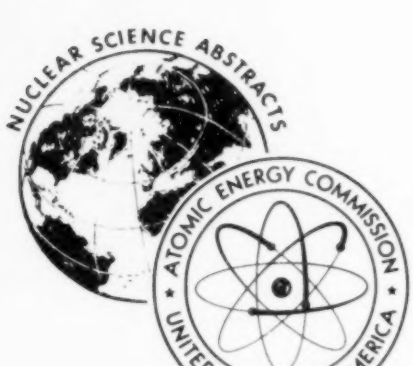

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Volume 16, Number 3 February 15, 1962

NUCLEAR SCIENCE ABSTRACTS

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NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

2814 (LAMS-2532(Vol.I)) MANHATTAN DISTRICT HISTORY, PROJECT Y, THE LOS ALAMOS PROJECT. VOLUME I. INCEPTION UNTIL AUGUST 1945. David Hawkins. VOLUME II. AUGUST 1945 THROUGH DECEMBER 1946. Edith C. Truslow and Ralph Carlisle Smith (Los Alamos Scientific Lab., N. Mex.). 1946 and 1947. Contract W-7405-eng-36. 390p.

Details are presented of the technical, administrative, and policy-making activities of the Los Alamos Project (Project Y) from its inception under the Manhattan District through the development of the atomic bomb. (J.R.D.)

2815 (TID-3567) SALINE WATER CONVERSION. A Literature Search. Henry J. Raleigh (Division of Technical Information Extension, AEC). Nov. 1961. 29p.

A bibliography is presented on the developments in the production of potable water from saline or brackish waters. The 372 references cover literature through September 1961. The report references are arranged alpha-numerically under the corporate authors. The journal references are arranged alphabetically by title. (M.C.G.)

2816 (TID-3708) INFORMAL LISTING OF BIBLIOGRAPHIES OF ATOMIC ENERGY LITERATURE. BIBLIOGRAPHIES ISSUED OR IN PROGRESS DURING THE PERIOD, OCTOBER–NOVEMBER 1961. (Division of Technical Information Extension, AEC). 26p.

A listing is presented of 155 bibliographies of atomic energy literature issued or in progress during the period of October and November 1961. The listing is alphabetical by corporate author. Subject, author, and report number indexes are included. (M.C.G.)

2817 (USNRDL-TR-530) NEUTRON DISTRIBUTIONS NEAR AN AIR-SOIL BOUNDARY AS A FUNCTION OF SOIL-WATER CONTENT. R. L. Mather (Naval Radiological Defense Lab., San Francisco). June 9, 1961. 29p.

The neutron flux from air-burst weapons as a function of energy and depth in the vicinity of the air-soil boundary at large distances from ground zero is investigated for several soil-water contents. Several aspects of the results are presented which conform with expectations. The results are briefly compared with the results from cyclotron experiments. (auth)

2818 (WT-85) BLAST LOADING AND RESPONSE OF MODEL STRUCTURES. APPENDIX E: BLAST LOADING AND STRUCTURAL RESPONSE. VOLUME III. Interim Report. Bert E. Pettitt (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Mar. 1951. Decl. July 19, 1961. For Fisher (Howard T.) and Associates, Inc., Chicago. Contract AF33(038)-9761. Project 3.3 of Operation GREENHOUSE. 258p.

The loads on the structure under the Greenhouse test conditions were analyzed and the calculations for three of the buildings are given: a closed building, a building with openings at one end and a building with openings at both front and back. The loadings for all of the idealized models are presented in some detail. The response of these idealized buildings to the predicted loadings is treated. The type of equation involved is discussed fundamentally and the method of solution is presented. Since the models are structurally similar, only one example is given. The essential results, displacement curves, and acceleration curves are presented for each structure. (auth)

2819 (WT-338) EVALUATION OF MISSILE HAZARD UNDERGROUND SHOT. R. B. Vaile, Jr. and V. Salmon (Stanford Research Inst., Calif.). May 1952. Decl. May 10, 1961. 44p. Project 4.5 [of] Operation JANGLE.

The missile experiment performed as a part of the JANGLE underground explosion test demonstrated that reinforced concrete walls and highways located 40 feet to 140 feet from ground zero were broken and thrown out as missiles. Material nearer than 40 feet was vaporized or pulverized to the extent that it was largely windborne. Missiles of military significance were found 400 feet to 3300 feet from ground zero. Those of major significance were in the range 400 feet to 1500 feet. Analysis has permitted estimates of the missile hazard from an underground explosion of roughly 25 times the energy release of the JANGLE underground explosion (and at the same scaled depth, $\lambda_c = 0.15$) fired under a continuous reinforced concrete runway 18 inches thick. It is predicted that missiles would produce serious damage to buildings out to a radius of 1100 feet and to airplanes out to 3000 feet. These figures should be compared to estimates that the air blast from such an explosion would damage buildings to 2200 feet and airplanes to 6000 feet. It is concluded that on large shallow underground explosions damage by the mechanism of air blast will extend farther than damage by the mechanism of missiles. (auth)

2820 (WT-714) DYNAMIC PRESSURE VS TIME AND SUPPORTING AIR BLAST MEASUREMENTS. C. D. Broyles (Sandia Corp., Albuquerque, N. Mex.). Feb. 1954. Decl. Aug. 21, 1961. Project 1.1d [of] Operation UPSHOT-KNOTHOLE.

Dynamic pressures in the shock wave and preshock pressures were measured during bursts Annie, Grable, Harry, and Climax. Feasibility studies of new and modified gages for the measurement of dynamic pressure, density, temperature, and particle velocity were conducted. When no precursor was formed, measured dynamic pressures were in reasonable agreement with those calculated using the Rankine-Hugoniot shock relations and regular reflection

theory, although some effects of thermal and mechanical interaction are noted. Dynamic pressures measured in the precursor were much higher than those calculated. Laboratory tests have indicated that the end instrument used responds to dust as well as air. Results of the gage feasibility study indicate that the q-tube and the centripetal density gage are suitable for use on full-scale nuclear tests. Both the modified sonic wind and sound speed indicator and the whistle temperature gage must be further modified before they are suitable for field use. (auth)

2821 (WT-1102) SHOCK WAVE PHOTOGRAPHY. J. F. Moulton, Jr. and E. R. Walthall (Naval Ordnance Lab., White Oak, Md.). May 15, 1958. Decl. July 11, 1961. 112 p. Project 1.2 [of] Operation TEAPOT. Supersedes ITR-1102.

Shock-wave photography includes two closely related techniques designed to detect and locate in space and time the various shock phenomena associated with nuclear bursts. Shock waves which are otherwise unobservable can be detected when photographed against a smoke trail grid. The technique was used during Operation Teapot to determine free-air peak pressures versus distance on the high-altitude shot, the position of the incident and reflected shocks as a function of time vertically above the burst of 3 shots, and if coalescence occurred, the peak pressures of the coalesced shocks as a function of distance above the burst, and the effects of the surface and heating of the air near the surface on precursor formation, growth, and shock wave interaction on 7 shots. Photographic records were also obtained on the underground shot to give information on the growth of the base-surge cloud and its role in the spread of radioactive contaminants. Photographic equipment and techniques are described and representative photographs are reproduced. Data are tabulated. (C.H.)

2822 (WT-1103) GROUND-LEVEL MICROBAROGRAPHIC PRESSURE MEASUREMENTS FROM A HIGH-ALTITUDE SHOT. J. W. Reed, J. R. Banister, and F. H. Shelton (Sandia Corp., Albuquerque, N. Mex.). [1955]. Decl. July 11, 1961. Project 1.3 [of] OPERATION TEAPOT. 27p.

Time records of incident and reflected overpressures from the high-altitude burst of Operation Teapot were obtained at an array of ground stations. Modified Sachs' scaling at sea level for 1 kt gave overpressure results in agreement with an extension of the pressure-distance curve determined from canister data. Acoustic refraction did not appreciably alter the pressure-distance effects. Shock-wave time parameters for this test were found to satisfy ordinary Sachs' scaling. An average pressure reflection factor of 0.92 was observed, but no correlation with surface parameters was obtained. (auth)

2823 (WT-1105) CRATER MEASUREMENTS. John G. Lewis (Engineer Research and Development Labs., Fort Belvoir, Va.). July 18, 1958. Decl. July 11, 1961. 76p. Project 1.6 [of] Operation TEAPOT. Supersedes ITR-1105.

Vertical shafts of colored sand were placed along one diameter through ground zero on Shot 7 to give a permanent record of the true crater. Measurement of the physical characteristics of the apparent crater and lip, and the true crater were made. The nuclear data obtained from Operation JANGLE surface and underground shots and TEAPOT Shot 7 were correlated with previous high explosive (HE) test results. Scaled curves of dimensions versus depth of burial with correlation between HE and nuclear bursts were developed for the Nevada Test Site soil as well as for several other soil types for which reliable HE data are available. Particular attention was given to the definition of the terms apparent and true craters, in light of their meaning being based on the movement of the soil, as depicted by the colored sand columns. A brief examination is made of the effects of energy density on the TNT equivalence of underground nuclear bursts. The change emplacement configuration can play a significant role in determining the TNT equivalence of a particular burst. (auth)

2824 (WT-1108) MATERIAL VELOCITY MEASUREMENTS OF HIGH-ALTITUDE SHOT. J. W. Reed, J. R. Banister, J. A. Beyeler, and F. H. Shelton (Sandia Corp., Albuquerque, N. Mex.). June 1956. Decl. July 11, 1961. Final Report, Project 1.9 [of] OPERATION TEAPOT. 20p.

Smoke puffs were used in an attempt to measure the behavior of the shock wave from Shot 10 at closer distances than those feasible for canister measurements. Errors in delivering the smoke puff canister placed the puffs outside the desired region and complicated the originally planned data reduction system. No significant conclusions could be drawn from the data because of excessive scatter. (auth)

2825 (WT-1109) AIRBLAST OVERPRESSURE AND DYNAMIC PRESSURE OVER VARIOUS SURFACES. D. C. Sachs, L. M. Swift, and F. M. Sauer (Stanford Research Inst., Menlo Park, Calif.). Sept. 9, 1957. Decl. July 11, 1961. Project 1.10 of Operation TEAPOT. Supersedes ITR-1109.

Static overpressure and dynamic pressure versus time over surfaces processing different physical properties were measured on two tower shots, 6 and 12. On Shot 12, three surfaces were provided: the natural desert, a water surface consisting of a flooded area, and an asphalt surface. On Shot 6, desert and asphalt areas only were available. There were 123 channels of instrumentation installed for Shot 12, and 24 for Shot 6. From the data, a system of wave-form classification was devised for overpressure and dynamic-pressure-versus-time measurements. Incorporation of this system into data analysis indicates that it is possible for an ideal peak pressure to be identified with a nonideal wave form. Introducing both variables, wave form and peak pressure, into analyses reduces ambiguities associated with comparing results of different nuclear tests. The data show the effect of the nature of the surface upon airblast phenomena from a nuclear explosion. The effects of surface conditions upon shock phenomena are made more understandable by a review of temperature computations, using shock wave parameters in addition to an analysis based upon the arrival time of the thermal pulse. A phenomenological discussion of precursor formation is presented, and comparisons are made using data from all known precursor-forming nuclear shots. Two Shot 12 drag-force measurements on the H Beams are presented and discussed. (auth)

2826 (WT-1110) SPECIAL MEASUREMENTS OF DYNAMIC PRESSURE VERSUS TIME AND DISTANCE. J. R. Banister and F. H. Shelton (Sandia Corp., Albuquerque, N. Mex.). Feb. 28, 1958. Decl. July 11, 1961. 66p. Project 1.11 [of] Operation TEAPOT.

Pitch and yaw of shock afterflow as a function of time, dynamic pressure parameters, and the contributions of air and dust to dynamic pressure were measured over desert, asphalt, and water surfaces during Shot 12. Little or no yaw of flow was detected, but pitch of flow was found to be considerable over all three surfaces to 2500 feet from ground zero. Over desert and asphalt, pitch-time records displayed a consistent pattern of initial upward flow followed by horizontal flow, or at 2500-foot stations, downward flow. Pitch-time records over water are erratic and little understood. Air dynamic pressures at 3-foot eleva-

tions, 2000 and 2500 feet from ground zero, were highest over desert and higher over asphalt than water. Considerable dust loading occurred on the desert where dust dynamic pressure exceeded that of air. Particle loading was present over asphalt, but the extent was not determined. No tangible evidence of water loading was found. Results suggest that high air dynamic pressures over desert and asphalt arise from air velocities higher than would be expected from the Rankine Hugoniot relations and measured overpressures. Some speculations are made about possible causes of these high velocities. (auth)

2827 (WT-1112) EVALUATION OF A RADIOLOGICAL DEFENSE WARNING SYSTEM (PROJECT CLOUDBURST). T. E. Petriken (Army Signal Engineering Labs., Fort Monmouth, N. J.). Aug. 16, 1957. Decl. July 11, 1961. 13p. Project 6.1.1b [of] Operation TEAPOT.

A radiological defense warning system was evaluated by exposure to nuclear detonations. The system evaluated consisted of thermal, gamma, and blast pressure detectors. Stations were located in overpressure regions of 1 psi on early events and moved to greater distances on later shots. The results showed that, in the overpressure region for which it was designed, the warning system operated successfully. (auth)

2828 (WT-1114) TRANSIENT DRAG CHARACTERISTICS OF A SPHERICAL MODEL. Final Report. Henry S. Burden (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Jan. 1957. Decl. July 11, 1961. Project 1.14a [of] Operation TEAPOT. 92p.

The measurement of aerodynamic drag forces exerted on simple shapes subjected to the air flow of a blast wave is described. For the test, hollow, string-mounted spheres were exposed to MET Burst. Stations comprised of one 3-in. and one 10-in. sphere were placed at ground ranges of 2000, 2500, and 2750 ft on each of three blast lines. The surface on each line was different: water cover, asphalt, and untreated desert. Also, on the desert line, a station was placed at ground range of 4500 ft and the compression-beam gage was placed at 2750 ft. The blast-wave types intended on these lines were clean-air, non-precursor; clean-air precursor; dust-laden air, non-precursor; and dust-laden air, precursor. Measurements taken showed drag coefficients of the same range of magnitudes as those found in wind-tunnel work, but definite comparisons were impossible since Reynolds' Numbers and Mach Numbers were not determined. Composite plots of drag coefficient vs dynamic pressure for a given diameter gage on the desert line showed a family of similar curves. Viscosity increases postulated to account for the great disparities in measured dynamic pressures computed for unheated, clean air were on the order of 10 to 10^4. (auth)

2829 (WT-1124) STUDY OF DRAG LOADING OF STRUCTURES IN THE PRECURSOR ZONE. L. A. Schmidt (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Jan. 30, 1959. Decl. July 11, 1961. 169p. Project 3.2 [of] Operation TEAPOT. Supersedes ITR-1124.

Information is presented on the effects of ideal and nonideal shock waves from a nuclear detonation on the drag loading of structures and structural components. Measurements were made of net pressures acting on identical concrete structures exposed on the following types of surfaces: a compacted desert surface, a desert surface in a loosened state, a water surface, and an asphalt surface. Pressures were measured on a cubical concrete structure in the precursor region for comparison with results obtained on the same structure during Burst 10 of Upshot-Knothole. The test measurements showed the same qualitative nature as that occurring on Upshot-Knothole, and the structure exposed to both operations showed results which were qualitatively the same, although different in detail. The detailed differences were attributed to local variations in surface conditions which can cause considerable perturbation in the flow patterns observed. The measured values of impulse on the test structures were very high compared to ideal dynamic-pressure impulse. A prediction scheme, developed as a result of Upshot-Knothole and involving a peak value of ideal dynamic pressure, gave reasonably good agreement. (auth)

2830 (WT-1126) BEHAVIOR OF UNDERGROUND STRUCTURES SUBJECTED TO AN UNDERGROUND EXPLOSION. G. K. Sinnamon, R. E. Woodring, N. M. Newmark, and F. Matsuda (Illinois. Univ., Urbana). Oct. 11, 1957. Decl. July 11, 1961. Project 3.3.2. of Operation TEAPOT. 48p. Contract DA-49-129-eng-324. Supersedes ITR-1126.

Two buried reinforced concrete four-walled structures without floor or roof were tested, one at 200 feet and the other at 250 feet from a 1.2 kt device buried at a depth of 67 feet. The structures were instrumented to give transient load and response data. In addition, provisions were made to obtain data on permanent displacements and strains. The crater formed by the explosion was unexpectedly small, being 146 feet in radius, so that the two targets were approximately 50 and 100 feet from the edge of the crater. The pressure measured on the front wall of the structure at the 200-foot range was approximately one-fourth of the stress of 125 psi in the medium, while the pressure measured on the front wall of the structure at the 250-foot range was slightly greater than the medium stress of 41.5 psi. The structures responded primarily as rigid bodies and followed the soil motion; consequently, there was no structural damage. The permanent movements of the boxes were 3.8 feet and 0.5 foot, horizontally, away from the point of burst. It is concluded that buried structures of the type tested are difficult to damage structurally, unless located within or close to the edge of the crater and that, for structures outside of the crater, problems created by large earth movements and throwout might be critical for structures relatively close to the edge of the crater. (auth)

2831 (WT-1129) EFFECT OF POSITIVE PHASE LENGTH OF BLAST ON DRAG AND SEMIDRAG INDUSTRIAL BUILDINGS, PART I. G. K. Sinnamon, J. D. Haltiwanger, F. Matsuda, and N. M. Newmark (Air Force Special Weapons Center, Kirtland AFB, N. Mex. and Illinois. Univ., Urbana). Dec. 1, 1958. Decl. Sept. 23, 1960. 118p. Project 3.7 [of] Operation TEAPOT.

A study was made of the effect of positive phase length of blast on drag-type and semidrag-type structures. Also, a further study was made of the general problem of drag loading and response of structures to blast forces. Four steel structures of single-story industrial type were tested. The drag-type structures with frangible sidings were exposed at 3600 and 4350 ft from ground zero. The semidrag-type structures with the reinforced concrete walls were located at 5000 and 5750 ft. Instrumentation was provided to obtain transient structural deflections, strains, and accelerations, as well as pressure-time curves at the structures. Structural properties were measured both before and after the test. Results of these tests are presented and information is included on the prediction of pressure levels and ranges. Procedures and data are given for shock tube tests on scaled models of the two types of structures tested in the field. (auth)

2832 (WT-1148) SPECTROMETER MEASUREMENTS. W. B. Plum and W. J. Parker (Naval Radiological Defense Lab., San Francisco). Jan. 27, 1958. Decl. July 24, 1961. 20p. Project 8.4d [of] Operation TEAPOT. Supersedes ITR-1148.

This experiment was performed to obtain data on the spectral distribution of the thermal radiation emitted in a nuclear explosion as a function of altitude. The radiant power versus time was measured with a time resolution of 100 μsec in 22 narrow spectral bands between 0.25 and 2.5 microns for the high altitude detonation and for the low altitude correlation shots. This was accomplished with vacuum phototubes and lead sulfide photoconductive cells, each sampling a different spectral region in the focal plane of a medium quartz Hilger spectrograph. The voltages produced by these detectors were recorded on two Ampex Model 306 magnetic-tape recorders. The spectral distribution at any given instant was obtained by plotting the radiant power per unit wavelength interval as measured by each of these detectors at that time. Data are tabulated. (auth)

2833 (WT-1149) AIR TEMPERATURE MEASUREMENTS OVER SEVERAL SURFACES. E. C. Y. Inn (Naval Radiological Defense Lab., San Francisco). Sept. 3, 1957. Decl. July 24, 1961. 40p. Project 8.4e [of] Operation TEAPOT. Supersedes ITR-1149.

Preshock air-temperature measurements in the vicinity of a nuclear detonation are reported. Although no data were obtained for close-in stations over water, asphalt, and desert, somewhat interesting but unusual results were obtained for stations of simulated terrain such as plots of ivy plants, fir boughs, wood, and concrete. The maximum air temperatures above ambient were found to be in excess of 1500°C over all plots. Furthermore, an increase in maximum air temperatures with elevation was found over all plots. Results of supporting high speed photographic coverage and gas analysis of air above irradiated plots are reported. An attempt to explain the results is given despite the lack of sufficient data. (auth)

2834 (WT-1403) AIR-BLAST PHENOMENA IN THE HIGH-PRESSURE REGION. L. M. Swift, D. C. Sachs, and A. R. Kriebel (Stanford Research Inst., Menlo Park, Calif.). Dec. 15, 1960. Decl. July 11, 1961. 130p. Project 1.3 of Operation PLUMBBOB.

Surface level and aboveground static overpressures, near-surface differential pressures, and near-surface total pressures were measured on Burst Priscilla. Gages were placed at ground ranges from 450 ft to 4500 ft, with a concentration of measurements in the high-pressure region. Blast switches, which measured arrival time only, were placed at several ranges, the closest at 100-ft range. A precursor wave formed near 500-ft ground range, and dissipated between 2000 and 2500 ft. Burst Priscilla shock velocity agrees with the ideal except between 500- and 2000-ft ranges where it exceeds the ideal. At high pressures, overpressures agree well with those predicted over an ideal surface, although surface maxima are depressed below the ideal curve. Total-head pressures obtained in the Mach reflection region agree with the ideal until 850 ft. From 850 to 2500 ft, peak total pressure is significantly higher than the ideal. Maximum differential pitot-tube pressures are higher than predicted over an ideal surface. Differential pressure wave-form classifications based on the degree of deviation from the corresponding overpressure wave form indicates that at close-in scaled ground ranges total-head pressure wave forms follow fairly closely those of the overpressure. Comparison of Hess' stagnation bubble theory with precursor phenomena suggests that this theory can be used to describe precursor formation. (auth)

2835 (WT-1404) GROUND ACCELERATION, STRESS, AND STRAIN AT HIGH INCIDENT OVERPRESSURES. L. M. Swift, D. C. Sachs, and F. M. Sauer (Stanford Research Inst., Menlo Park, Calif.). May 10, 1960. Decl. Aug. 14, 1961. 131p. Project 1.4 [of] Operation PLUMBBOB.

Measurements were made to determine the underground effects of nuclear air bursts as they vary with time, depth, and ground range, particularly in the region of high pressure. Analyses were made of the data obtained in combination with the results of other tests to establish criteria for the prediction of underground effects. In addition, seismic studies were performed at Frenchman Flat. At 750 and 1050 ft from ground zero, acceleration, stress, and strain measurements were made at several depths down through 50 ft, including two measurements each of horizontal acceleration and stress. At 450, 550, 650, 750, 850, 1050, and 1350 ft, vertical acceleration and stress were measured at 50- and 10-ft depths. Wave forms of acceleration and velocity showed no ideal or classical shape but could be grouped in six categories according to their characteristics. Outrunning occurred at the ground surface at 2500-ft ground range from a signal originating at 1900-ft ground range. Attenuation of maximum downward acceleration at 5- and 10-ft depths varied between 30 and 45% except at 550- and 650-ft ranges where it was negligible. Horizontal acceleration at 10- and 50-ft depths was attenuated less with depth than was the corresponding peak downward acceleration. In stress-strain relations, it was tentatively concluded that laboratory triaxial tests were more useful in correlation with blast results than were compaction tests. (auth)

2836 (WT-1406) LOADING ON SIMULATED BURIED STRUCTURES AT HIGH INCIDENT OVERPRESSURES. E. H. Bultmann, Jr., G. F. McDonough, and G. K. Sinnamon (Illinois. Univ., Urbana). Apr. 18, 1960. Decl. Aug. 14, 1961. 103p. Project 1.7 [of] Operation PLUMBBOB.

A study was made of the factors affecting transmission of air-induced ground pressures and loadings produced on buried structures by such pressures. The test involved 68 devices composed of rigid cylinders with deformable-diaphragm ends. Five diaphragm thicknesses were used to simulate structures of different flexibilities. The drums were buried at depths ranging from 0 to 20 ft at three different locations. The average effective peak surface overpressures from Burst Priscilla, as measured by surface diaphragms and pressure-time devices, were 321, 108, and 62 psi, respectively, for the near, intermediate, and far locations. Static measurements made on the diaphragms before and after the test consisted of strain-gage readings and permanent-deflection measurements. Transient strain measurements also were made on some of the diaphragms. A laboratory program was conducted to calibrate the field test devices. The results indicated that there was a considerable decrease with depth of the air-induced ground-transmitted pressure, as indicated by pressures on similar diaphragms at different depths. This amounted to 70% in 20 ft. Pressures on the thinnest diaphragms were found to be as low as 50% of the estimated pressure in the soil surrounding the drum when the drum was at a depth equal to its span. The pressure on vertical diaphragms, i.e., horizontal drums, varied from 0.25 to 0.53 of the pressure on horizontal diaphragms. The simplified theory developed gave reasonable predictions of the measured pressures on the buried drums. (auth)

2837 (WT-1487) SPECTRA OF GROUND SHOCKS PRODUCED BY NUCLEAR DETONATIONS. J. F. Halsey and M. V. Barton (Air Force Ballistic Missile Div., Inglewood, Calif.). Aug. 17, 1959. Decl. Sept. 20, 1961. Project 1.9 of OPERATION PLUMBBOB. 34p.

Self-contained mechanical reed gages, capable of measuring the displacement shock spectrum over a frequency range of 3 to 300 cps in any one direction, were placed on Bursts Stokes, Smoky, Galileo, Whitney, and Charleston. Canisters containing the gages were normally placed with tops flush to the ground level at predicted pressure levels of approximately 100 psi; however, on Smoky two additional gages were placed on the floor of an earth-covered-personnel shelter, and two gages were installed on a concrete block for Whitney. A composite plot of the results of surface gages from Smoky, Galileo, and Whitney (overpressures from 116 to 146 psi) indicates some very definite trends. The displacements are two to three times higher at three cps for the vertical component (3 in. to 5.5 in.) than for the radial component (1 in. to 2 in.). The rate of decrease of displacement with increasing frequency is greater for the vertical component than for the radial component. A comparison of the results from the surface gages and those within the structure and Smoky indicates an attenuation factor of three for vertical displacements, with no appreciable change in the radial direction. (auth)

2838 (UCRL-Trans-717(L)) THE PEACEFUL USE OF NUCLEAR BOMBS IN CIVIL ENGINEERING. Th. Ginsburg. Translated by M. S. Little (Univ. of California Lawrence Radiation Lab., Livermore) from Neue Zürcher Ztg., No. 176, 18-21(June 29, 1961). 68p. (Includes original, 9p.).

The possible applications of atomic explosions to civil engineering problems, particularly massive evacuations, are treated in detail. The projects involved in Operation Plowshare are discussed. The results obtained in the Neptune underground explosion are discussed, and the processes leading to crater formation are elucidated. The possibility of radioactive contamination of the biosphere by underground and air bursts is considered. Prediction of crater dimensions and profiles in atomic explosions is discussed. The safety measures taken in planning of Project Chariot are given. The applications of atomic explosions to canal projects in Central America are treated from an economical and safety standpoint, and it is concluded that these projects must await the completion and evaluation of the Project Chariot results. The application of atomic explosions to breaking up undesirable earth landslides and embankments is discussed with especial reference to the 1959 earthquake at Madison River in the Yellowstone National Park. (D.L.C.)

2839 ATOMIC SCIENCE AND TECHNIQUE AND BUILDING OF COMMUNISM. V. S. Emel'yanov. Atomnaya Energ., 11: 301-12(Oct. 1961). (In Russian)

Atomic energy, being a highly concentrated source, contributes greatly to the coverage of the energy needs of the Soviet population. Radioisotopes were used to automate many industrial processes and found many applications in science and medicine. The first atomic power station in the world operated continuously for 7 years at a power level of 5000 kw. The 100,000-kw I. V. Kurchatov uranium–graphite reactor at Beloyarsk was constructed on the basis of a novel Soviet design, operating with low-enrichment fuel and superheated steam under a pressure of 100 atm. It represents a highly advanced stage of the nuclear power technology. At the Novo-Voronezh power station, water-moderated, water-cooled reactors, each with a power of 210,000 kw(e) are used. The Soviet Union provided help in the construction of the East German and Czechoslovak research reactors. The problem of extracting and purifying U^{233} and Pu from fission products continues to receive attention. Ship propulsion by atomic power is represented by the atomic icebreaker "Lenin." The basic research in progress at scientific institutions, including accelerators, the structure of the nucleus, fusion, and others, are reviewed. (TTT)

2840 MAGNETOPLASMADYNAMIC ELECTRICAL POWER GENERATION. B. C. Lindley (Nuclear Research Centre, C. A. Parsons and Co., Ltd., Newcastle-on-Tyne, Eng.). Brit. Power Eng., 3: No. 5, 30-7(Oct. 1961).

A review is given of the recent development work in the United States on magnetoplasmadynamic power generation and the future of the steam stations in the United Kingdom. Investigations show that the efficiency of thermal power stations can be expected to rise to about 45% within the next twenty years. However the efficiency of a magnetoplasmadynamic power generation station is expected to be higher and is suitable for bulk generation. (N.W.R.)

2841 SOME CHARACTERISTICS OF SURFACE WAVES IN THE SEA PRODUCED BY NUCLEAR EXPLOSIONS. William G. Van Dorn (Scripps Institution of Oceanography, La Jolla, Calif.). J. Geophys. Research, 66: 3845-62(Nov. 1961).

Low-frequency dispersive gravity waves produced by nuclear explosions at Bikini, Marshall Islands, were recorded at four distant island stations. The results of these wave measurements are compared with those predicted by linear theory, and good agreement is observed in the nature of the dispersion and the rate of amplitude decay with distance. The wave system associated with the large tsunami of March 9, 1957 is also considered. The dispersion for both types of disturbances was virtually identical, in agreement with the theoretical argument that the dispersion of a centered wave system is independent of the nature of the source disturbance. In analyzing the rate of amplitude decay, it was found necessary to correct the observations for enhancement due to scattering by the islands upon which the recording stations were located, showing that even relatively small islands are effective as scatterers. These experiments show rather conclusively that tide-gage records of tsunami-like disturbances are grossly misleading insofar as the characteristics of the wave systems in the open sea are concerned. (auth)

2842 SEMICONDUCTOR ABSTRACTS. Abstracts of Literature on Semiconducting and Luminescent Materials and Their Applications. Volume VI, 1958 Issue. J. J. Bulloff and C. S. Peet, eds. New York, John Wiley & Sons, Inc., 1961. 536p. (AFOSR-TR-60-167)

A compilation of 1933 abstracts of literature on semiconducting and luminescent materials and their applications is presented for the year 1958. Author and subject indexes are included. (N.W.R.)

2843 DATA PROCESSING AND PROGRAMMING. OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). Aug. 1961. 26p. (SB-474). $0.10(OTS).

A bibliography is presented on data processing and programming. The 351 references were added to the Office of Technical Services collection during the period 1959 to September 1961. (M.C.G.)

BIOLOGY AND MEDICINE

General and Miscellaneous

2844 (NP-11065) RADIATION STERILIZATION OF COCOA POWDERS. Report No. 5 (Final), February 17, 1959–February 16, 1961. M. E. DeBenedictis (Nestle Co., Inc., White Plains, N. Y.). Contract QMR&E (NATICK) No. 114. 7p.

Results of studies on the effects of various dosages of γ radiation upon the blooming characteristics and flavor of chocolate coatings, cocoa, and chocolate syrup showed that dosage levels that produce satisfactory results for controlling microorganisms in cocoas, cocoa butters, and chocolate coatings result in the development of off-flavors. No off-flavors were detected in chocolate syrups with a low fat content. (C.H.)

2845 (NP-11067) RADIATION PRESERVATION OF FRESH STRAWBERRIES AND GRAPES. Report No. 3 (Final), March 5, 1959–March 5, 1961. Roger J. Romani, E. C. Maxie, and Betty J. Robinson (California. Univ., Davis). Contract QMR&E (Natick) No. 115. 4p.

A study was made of the effects of radiation processing on the keeping qualities of pears. Both γ and β exposure prolonged the ripening process in the fruit. Data are included on the effects of radiation on respiration of the fruit. Methods are described for preparing enzyme extracts and lyophilized material for biochemical studies. (C.H.)

2846 (NP-11068) CORROSION STUDIES OF IRRADIATED CANNED FOODS. Report No. 6 (Final), December 17, 1954–December 31, 1960. G. B. Pratt (American Can Co., Barrington, Ill.). Contract QMR and D (NATICK) No. 12. 22p.

Gamma radiation of 3.25 Mrad had no adverse effects on the metal, enamel coating, or end lining compound of tinplate cans. The longest shelf-life for irradiated green beans in tinplate cans was 16 mo. It was concluded that the problem of early failure of enamel on the ends of these cans could be avoided by the use of unenameled hot dip plate for the ends, as well as bodies of the cans. A study was made of causes of gas production in food products during irradiation. Ground beef packed in polyethylene tubes with experimental epoxy resin coatings and exposed to 6 Mrad γ radiation showed surface darkening after one month. Plastic bags of chili con carne and cherries were exposed to 6 Mrad γ radiation. Only polyester Scotch-Pak containers of chili did not leak after 3 mo storage at 98°F. Cherries were held 3 mo at 98°F without leaks by vinyl, nylon, polyvinyl chloride on Mylar, and metallized Mylar bags. Saran and Genitron bags leaked with both products. (C.H.)

2847 (NP-11082) DEVELOPMENT OF IRRADIATION STERILIZED MEAT PRODUCTS. Report No. 8 (Final), January 15, 1959–January 14, 1961. W. J. Stadelman (Purdue Research Foundation, Lafayette, Ind.). Contract DA19-129-QM-1364. 29p.

Procedures were developed for preparing acceptable irradiation sterilized poultry meat items. Charcoal barbecuing of chicken and turkey with a tomato paste base sauce masked the irradiation flavor, odor and color. Data are presented on several factors affecting flavor, odor, color, and tenderness of irradiated poultry meat. (auth)

2848 (NP-11083) ACTIVATION ANALYSIS OF FOODS FOR CHARACTERIZATION OF THE INDUCED RADIOACTIVITIES. Report No. 3 (Final), May 10, 1960–February 9, 1961. R. C. Koch (Nuclear Science and Engineering Corp., Pittsburgh). Contract DA19-129-QM-1601. 56p.

Results are reported from determinations on the elemental concentrations of a wide variety of elements in beef, pork, ham, and chicken made by activation analysis. The resulting analytical data, combined with concurrent determinations of radioactivity balances in each food, will provide a basis for radiochemical characterization of the neutron-induced activities found or expected to be found in foods after sterilization at several types of irradiation facilities. Data on elemental concentrations in the foods are tabulated. (C.H.)

2849 (NP-11114) EFFECTS OF IRRADIATION ON CANNED FOOD PRODUCTS. Report No. 2 (Final), March 8, 1957–March 7, 1961. P. K. Bates (Carnation Co., Van Nuys, Calif.). Contract QMR&D (NATICK) No. 75 (Agreement). 9p.

The irradiation of frozen beef and chicken vegetable pies with dosages of 1×10^5, 3×10^5, and 5×10^5 rads resulted in pies inferior to unirradiated samples in appearance, odor, texture, and flavor. Results are included from preliminary studies on the incorporation of an oxygen scavenger for improving the quality of canned irradiated meat products. (C.H.)

2850 (TID-14285) AN ECOLOGICAL AND TAXONOMIC SURVEY OF AQUATIC BIOTA IN AN ANDEAN TRANSECT AT THE EQUATOR. Sub-terminal Progress Report. G. W. Prescott, Norman R. French, and Ronald Hodges (Michigan State Univ., East Lansing). Nov. 1, 1961. Contract AT(11-1)-583. 21p.

Preliminary data are presented from an ecological and taxonomic survey of aquatic biota of the lakes, streams, and bogs of the lower altitudes on both sides of the Andes mountains in Ecuador. Information is presented on the plants and animals in the water, the productivity of the waters, and the chemical characteristics of the waters in relation to the quantity and quality of the biota. General descriptions of regions at the altitudes represented by 35 sampling stations are included. (C.H.)

2851 (JPRS-10879) THE EXPERIENCE OF HETEROTRANSPLANTATIONS OF A FEMALE BREAST TUMOR INTO THE ANTERIOR EYE CHAMBER AND THE MAMMARY GLAND OF GUINEA PIGS. A. A. Nesterova. Translated from Eksptl'. Khirurg. i Anesteziol., No. 4, 53-7 (July-Aug. 1961). 8p.

The survival of female breast tumors transplanted into the anterior eye chamber and mammary gland of guinea pigs after administration of female sex hormone to the pigs was studied. Some of the results were positive, and it is concluded that disturbance of the hormonal balance in the animal weakens its protective forces and that the pigmented eye tissue plays an important role in the regression of the transplant. (D.L.C.)

2852 STERILIZATION OF MEAT BY RADIATION. Yotsuo Toriyama and Tei Sato (Musashi Inst. of Tech., Japan). Genshiryoku Kōgyō, 6: No. 9, 50-2(Sept. 1960). (In Japanese)

Among the disadvantages of cold sterilization and preservation of food by high radiation doses are the discoloration and formation of undesirable odors in the irradiated material. In order to overcome these disadvantages, the "electro smoking" solution method was tested. The highly irradiated food yielded satisfactory results presenting the

advantages of both methods. Experimental details of the method are given. (TTT)

2853 INVESTIGATION OF THE SURFACE PASTEURIZATION, BY MEANS OF SOFT X-RAYS, OF PACKED SAMPLES OF FISH AND MEAT CONTAINING INNER BACTERIA. W. Schmidt-Lorenz and A. Berger (Bundesforschungsanstalt für Lebensmittelfrischhaltung, Karlsruhe, Ger.). Intern. J. Appl. Radiation and Isotopes, 11: 161-73 (Nov. 1961). (In German)

The effect of surface irradiation on the composition of the microflora, and the distribution of the viable counts between surface layers and the inside of the samples was examined before and after irradiation with 60 kv x rays at a surface dose of 3 mr. Prepacked seafish and beef samples not sterile inside were irradiated from above, and moved round to ensure uniform surface dosage. Short freezing (–24°C, 12 hr) after irradiation, necessary for the separation of the surface layers, did not affect the results of the bacterial counts. In the surface layers of the fish and beef samples the reduction of the viable counts through irradiation was low (90 to 98%) in spite of the high surface dose. Even composition of the microflora was not much affected. Only a low reduction of viable counts (70 to 80%) was attained in the inside through irradiation of infected samples. The viable counts were not reduced but clearly increased after irradiation in the inside of less-infected samples. For this increase different types of Pseudomonas and Achromobacter were mainly involved. These unexpected results could be explained only through a re-infection of the irradiated surfaces with the packaged samples and through a secondary distribution of the bacteria inside the tissue through the drip, which is produced by irradiation. An effective surface irradiation of packaged raw fish and beef seems only to be possible through irradiation directed from the bottom to the surface, e.g., only on the underside of the samples. (auth)

2854 BEREIDING EN METABOLISME VAN J^{131}-SERUM-ALBUMINE. (Preparation and Metabolism of I^{131}-Serum-Albumine). K. S. Wiarda. Thesis, Leiden, Universiteit, 1960. 62p.

The fractionation of serum proteins by column electrophoresis in a density gradient is described. A procedure for labeling serum albumin with I^{131} is developed in which cyclohexane is used as an organic solvent for iodine. By means of ICl_3 iodine is converted into ICl, which leads to higher yield in the iodination reaction. The difference in electrophoretic mobility between albumin and iodinated albumin is studied as a function of the pH of the buffer used. Some features in albumin metabolism are surveyed. The results are given of a study concerning the influence of body-weight, age, and strain differences on albumin metabolism in rabbits. After irradiation with 600-r x rays, the catabolic rate of serum albumin, measured as t/2 in plasma, increased in the Alaska rabbit. No such increase is observed after irradiation with 300 r. Both hypo-albuminemia and diarrhoea in rats after irradiation with 600-r x rays disappeared with oral administration of tetracyclines. (NPO)

2855 IMPROVEMENTS IN OR RELATING TO PRESERVING MEAT AND FISH. (to Chas. Pfizer & Co., Inc.) British Patent 880,687. Oct. 25, 1961.

A process for preserving fresh meat or fish is outlined which combines irradiation and antibiotic treatments with a greater effect than either treatment alone. The process comprises contacting the foodstuff with an antibiotic and exposing to ionizing radiations at pasteurization levels, i.e., 6.5 to 10×10^4 rep. The antibiotic preferredly is a tetracycline antibiotic mixed with a sorbic acid compound, and the radiation preferredly is gamma for thick meat slices and beta for thin slices. The process may be used to obtain a shelf life of 2 weeks even for very poor quality meats. (D.L.C.)

Biochemistry, Nutrition, and Toxicology

Refer also to abstract 3286

2856 (ANL-6398) RADIOLOGICAL PHYSICS DIVISION SEMIANNUAL REPORT, JANUARY–JUNE 1961. (Argonne National Lab., Ill.). Sept. 1961. Contract W-31-109-eng-38. 134p.

Twenty papers are presented on various projects pursued in the Radiological Physics Division. The topics of the papers include radioactivities of bone and air, cesium-137 content in human subjects, liquid scintillators, fluid flow, and air and soil temperature cycles. Separate abstracts were prepared for 16 of the papers. (D.L.C.)

2857 (ANL-6398(p.3-4)) A STUDY OF THE MECHANISM OF ENERGY TRANSFER FROM NAPHTHALENE TO α-NPO. I. B. Berlman (Argonne National Lab., Ill.).

The energy transfer parameter (ϵ) of xylene solutions containing 10 g/l naphthalene and 0 to 1 g/l (C) 2-[1-naphthyl]-5-phenyloxazole (α-NPO) were determined using excitation by 2890 A u-v radiation. A plot of C/ϵ vs C is generally linear, except in the low C region of 0 to 0.1 g/l, where a falling off takes place, indicating more than one decaying naphthalene level. (D.L.C.)

2858 (ANL-6398(p.5-23)) DETAILED AUTORADIOGRAPHIC AND MICRORADIOGRAPHIC STUDIES OF BONE FROM HUMAN RADIUM CASES. R. E. Rowland (Argonne National Lab., Ill.).

The observations collected on bone samples from five radium cases are described in detail. The cases include an Elgin State Hospital patient and several dial painters. (D.L.C.)

2859 (ANL-6398(p.24-35)) AN EVALUATION OF THE INCOMPLETE GAMMA FUNCTION OVER A RANGE OF BIOLOGICALLY SIGNIFICANT VALUES. R. E. Rowland and Constance J. Leuer (Argonne National Lab., Ill.).

The integral $\int e^{-\lambda t}\, t^{-b}\, dt$ common in many radiobiological problems, e.g., retention of isotopes in bone, is similar in form to the gamma function $\Gamma(p+1) = \int_0^\infty e^{-x}\, x^p\, dx$. For the case of integration limits between 0 and a finite value of t, the incomplete gamma function is defined as $\Gamma_x(p+1) = \int_0^x e^{-x}\, x^p\, dx$. The incomplete gamma function is evaluated for a range of variables appropriate to many biological problems and expressed to four-figure accuracy. (D.L.C.)

2860 (ANL-6398(p.36-9)) MICRORADIOGRAPHIC APPEARANCE OF BONES SUBJECT TO CHRONIC VASCULAR INSUFFICIENCY. R. E. Rowland (Argonne National Lab., Ill.).

Six bone samples from amputations of extremities following atherosclerotic gangrene were studied. Hypercalcification similar to bone damage in radium cases were found to occur in all cases, e.g., plugged canals, mineral-filled lacunae, sclerotic edges around the haversian canals, and hypercalcified osteons. The results lend support to the hypothesis that much of the damage to bone from deposited radium is actually vascular damage. (D.L.C.)

2861 (ANL-6398(p.41-2)) IN VIVO MEASUREMENT OF Cs^{137}: SUMMARY OF OBSERVATIONS UP TO JUNE

1961. Charles E. Miller and John B. Corcoran (Argonne National Lab., Ill.).

Data are presented on eight control human subjects monitored for Cs^{137} from April 1956 through June 1961, expressed as $\mu\mu c$ Cs^{137} per g body K. Plots of the data show that the Cs^{137} content increased quite rapidly from March 1955 to April 1956, remained quite constant until 1957, increased again uniformly to a maximum of 65 $\mu\mu c$ Cs^{137}/g K in June 1959, and thereafter decreased to a level lower than any time since April 1956. The half time of 17 months derived from the semilog plot of the 1960 and 1961 data is consistent with the decrease in average atmospheric concentration. (D.L.C.)

2862 (ANL-6398(p.46-9)) LIQUID SCINTILLATOR SOLVENT STUDY FOR THE PURPOSE OF IMPROVING THE "TWIN" SCINTILLATION FAST NEUTRON DETECTOR. PART II. Roger Grismore (Argonne National Lab., Ill.).

Results of relative light yield measurements are presented for solutions of 4 g/l diphenyloxazole in various organic solvents. Measurements with a Co^{60} gamma-ray source were made with 2,5-difluorotoluene and mineral oil as solvents, while measurements with a Cs^{137} internal conversion electron source were made with monoisopropylbiphenyl, heptane, hexane, decalin, and hexadecane as solvents. The results indicate that a combination of 1,4-difluorobenzene or 2,5-difluorotoluene and hexane, heptane, or hexadecane would be a decided improvement over the combination of fluorinated xylene and paraxylene now used for the solvents in the "twin" scintillation fast neutron detector. (D.L.C.)

2863 (ANL-6398(p.51-62)) RADIOACTIVITY IN BONES OF PATIENTS INJECTED WITH THOROTRAST. II. VARIATIONS IN DISTRIBUTION IN THE CORTICAL, TRABECULAR AND MARROW PORTIONS. Dorothy E. Wallace, Henry F. Lucas, Douglas P. Krause, and Frank H. Ilcewicz (Argonne National Lab., Ill.).

Bone samples from a thorotrast patient were analyzed for Ra^{228}, Th^{229}, and Th^{232} to provide a picture of the distribution of Th^{232} and its daughters in bone fractions. Other thorotrast cases previously reported are described. (D.L.C.)

2864 (ANL-6398(p.63-6)) FURTHER OBSERVATIONS ON Th^{228} AND Ra^{226} IN BONES FROM DIAL PAINTERS AND MEDICAL PATIENTS. Dorothy E. Wallace (Argonne National Lab., Ill.).

Results of Th^{228} and Ra^{226} analyses are presented for bone samples from four of Martland's dial painters, another dial painter, and a medical patient to which radium solutions were administered. (D.L.C).

2865 (ANL-6398(p.67-70)) Th^{228} AND Ra^{226} ANALYSES OF BONES FROM KERALA, INDIA. Dorothy E. Wallace (Argonne National Lab., Ill.).

Bones from seven subjects in Kerala, India, were subjected to Th^{228} and Ra^{226} analysis, and the results are compared with the Th^{228}/Ra^{226} ratios of bones from natural Ra^{226} activity sources. (D.L.C.)

2866 (ANL-6398(p.71-6)) FURTHER STUDIES ON NATURAL RADIOELEMENTS IN BOVINE BONES AND TEETH. Elvira R. Di Ferrante (Argonne National Lab., Ill.).

Twenty-five samples of bovine jawbones with teeth were analyzed for Ra^{226} contents. The data, plotted as Ra^{226} content vs tooth formation time, show that the skeletal burden may be inferred from teeth formed between ~2 and 4 years of age. Results were also obtained for pig and deer bones; pigs and deer were found to show a much lower and higher Ra^{226} bone content, respectively, than the average bovine value. The bovine jawbones were also analyzed for Po^{210}. (D.L.C.)

2867 (ANL-6398(p.77-80)) STABLE LEAD IN HUMAN BONE. Douglas P. Krause (Argonne National Lab., Ill.).

Lead in 12 cortical bone specimens was separated by diethyl dithiocarbamate extraction and determined colorimetrically with dithizone. The range of the data is from 4.0 to 59.0 μg Pb/g ash with an average value of 24.8 μg Pb/g ash. The data are compared with other work on various types of bone. A plot of concentration vs age suggests a possible correlation between lead concentration and age, with the higher lead concentrations occurring at higher ages. (D.L.C.)

2868 (ANL-6398(p.81-5)) FISSION AND NATURAL RADIOACTIVITY IN GROUND LEVEL AIR. Philip F. Gustafson, Michael A. Kerrigan, and S. S. Brar (Argonne National Lab., Ill.).

Filter papers exposed on air pumps on and around the Argonne site from 1958 to 1961 were analyzed for radioactivities and results presented for Cs^{137}, Be^{7}, W^{181}, and Rh^{102}. A spring maximum is observed in the Cs^{137} content vs time curve. The activity ratios for various nuclear explosion test series are used to decide the source of debris settling into the surface air and to resolve the Cs^{137} content into components originating from individual test series. The resolved Cs^{137} data are then used to estimate the mean stratospheric residence times for individual test series. (D.L.C.)

2869 (ANL-6398(p.86-95)) MULTIPLE REGRESSION EQUATIONS RELATING METEOROLOGICAL VARIABLES WITH EIGHT-HOUR AVERAGE RADON CONCENTRATIONS. Harry Moses (Argonne National Lab., Ill.).

The "screening technique" of multiple regression analysis is used to relate observed eight-hour average radon concentrations in air with weather conditions in the immediate vicinity. The effects of vertical diffusion and precipitation on radon concentration are taken into account. Improvement of the analysis by additional variables is discussed. (D.L.C.)

2870 (ANL-6398(p.96-109)) THE ARGONNE METEOROLOGICAL MODEL TOWING TANK; TWO-DIMENSIONAL JETS IN A STRATIFIED FLUID. Paul Frenzen (Argonne National Lab., Ill.).

Results are summarized for a series of experiments designed to study stratified jet flows formed in the later stages of turbulent decay within stably stratified water in the lee of a moving, rectangular grid, and to examine the dependence of these flows on the shear-stability ratio of "internal" Froude number. The experiments were carried out over a range of flow rates and in a variety of fluid stability conditions. (D.L.C.)

2871 (ANL-6398(p.110-29)) ANALYSIS OF SOIL- AND AIR-TEMPERATURE DATA BY FOURIER TECHNIQUES. James E. Carson (Argonne National Lab., Ill.).

Data for air temperature and soil temperatures at various depths at the Argonne site are presented for 1955. The annual cycles of air and soil temperatures for 1953 to 1955 are subjected to harmonic (Fourier) analysis, and the results are used to derive thermal diffusivities of the soil at various depths. (D.L.C.)

2872 (TID-14283) STUDIES ON INTEGRATED ENZYME ACTIVITY IN ANIMAL TISSUES. Annual Progress Report No. 12, November 1, 1960–October 31, 1961. David E. Green (Wisconsin. Univ., Madison. Inst. for Enzyme Research). Contract AT(11-1)-64. 7p.

Data are presented from a series of studies on the structural protein, electron transport chain, and enzyme systems of mitochondria. A list of publications resulting from the studies is included. (C.H.)

2873 (TID-14308) METABOLIC PATHWAYS IN MICROORGANISMS. Final Report. Illinois. Univ., Urbana). [1961]. Contract AT(11-1)-67. 10p.

Results are summarized from a series of studies on metabolic pathways in microorganisms in which C^{14}, S^{35}, and H^3 were used as tracers. (C.H.)

2874 (UCLA-485) PLANT UPTAKE OF RADIOISOTOPES FROM SOIL CONTAMINATED WITH MIXED FISSION PRODUCTS. E. M. Romney, H. Nishita, J. H. Olafson, and K. H. Larson (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). Aug. 10, 1961. Contract AT(04-1)-GEN-12. 27p.

The yield of wheat was not affected by solutions of mixed fission products incorporated into, or applied onto the surface of equal amounts of potted soil when the beta activity levels ranged from 0.01 to 1.5 microcuries per gram of soil. Wheat removed from 0.07 to 0.09% of the beta activity that was incorporated into the soil, and from 0.10 to 0.15% of the beta activity applied onto the surface of the soil. In plants, the beta and gamma activities were highest in leaves, intermediate in stems, and the lowest in fruiting heads. Radiostrontium contributed from 60 to 90% of the beta activity accumulated by wheat plants. The length of the plant growth period, soil type, and the addition of calcium and organic amendments to the soil altered the absorption of beta activity through roots from the contaminated soil. (auth)

2875 (UCLA-487) THE TOXICOLOGICAL AND PHARMACOLOGICAL EFFECTS OF HAFNIUM SALTS. Thomas J. Haley, K. Raymond, N. Komesu, and H. C. Upham (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). Sept. 1, 1961. Contract AT(04-1)-GEN-12. 12p.

The toxicology and pharmacology of hafnium salts was investigated. Acute intraperitoneal toxicity of hafnyl chloride is of the delayed type with an LD_{50}/7 days of 112(93.3 to 134.4) mg/kg. Chronic feeding for 90 days at levels of 1.0, 0.1, and 0.01% of the diet produced liver changes at the 1.0% level. No changes were observed in the growth rate or the hemogram. Ocular application produced a transient conjunctivitis. Topical application to intact rabbit skin produced a transient irritation whereas similar studies on abraded skin resulted in nonhealing ulcers. Intradermal injections also produced localized irritation and scar formation. Hafnyl chloride had a depressant effect upon isolated rabbit and guinea pig ileum. In the intact cat, the compound produced hypotension and death by cardiovascular collapse and respiratory paralysis. The chemical had no effect on the responses to acetylcholine, epinephrine, or histamine or those elicited by stimulation of the cervical sympathetic or vagus nerves. (auth)

2876 (UCLA-491) PHARMACOLOGY AND TOXICOLOGY OF NIOBIUM CHLORIDE. Thomas J. Haley, N. Komesu, and K. Raymond (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). Oct. 10, 1961. Contract AT(04-1)-Gen-12. 12p.

The acute intraperitoneal and oral LD_{50}/7 days of 61 (56.1 to 66.4) mg/kg and 940 (929.8 to 950.3) mg/kg showed that niobium chloride was one of the most toxic of the rarer chemicals. After feeding niobium chloride to groups of rats for 12 weeks, no significant changes were noted in either growth rate or the hemogram, but liver damage was observed. Localized severe damage to the skin was produced by direct contact with the chemical. Transient ocular irritation but no permanent damage was also produced by direct contact with the chemical. Niobium chloride produced cardiovascular collapse and respiratory paralysis in the cat at a dose of 5 mg/kg, but did not affect the pharmacological responses to epinephrine, acetylcholine, or histamine or those produced by stimulation of the cervical sympathetic or vagus nerves. (auth)

2877 (UCLA-492) THE TOXICOLOGICAL AND PHARMACOLOGICAL EFFECTS OF GADOLINIUM AND SAMARIUM CHLORIDES. Thomas J. Haley, K. Raymond, N. Komesu, and H. C. Upham (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). Oct. 15, 1961. Contract AT(04-1)-GEN-12. 13p.

A study was made of the toxicology and pharmacology of gadolinium and samarium chlorides. The symptoms of acute toxicity following intraperitoneal injections are described. The chronic oral ingestion of both chemicals for 12 weeks produced no effects on growth or the hemogram, and only the male rats receiving gadolinium chloride showed liver damage. The pharmacological responses to both chemicals were mainly depressant on all systems studied, and death was associated with cardiovascular collapse coupled with respiratory paralysis. The greatest damage seen was on abraded skin, where non-healing ulcers were produced by both chemicals. Irritation of intact skin and ocular tissues was only transient in nature. (auth)

2878 (UCRL-Trans-737) INCORPORATION OF O^{18} FROM HEAVY OXYGEN WATER IN VIOLAXANTHENE UNDER THE EFFECT OF LIGHT ON PLANTS. D. I. Sapozhnikov, D. G. Alkhazov, Z. M. Eidel'man, N. V. Bazhanova, I. Kh. Lemberg, T. G. Maslova, A. B. Girshin, I. A. Popova, V. S. Saakov, O. F. Popova, and G. A. Shiryaeva (Shiriaeva). Translated by S. Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Botan. Zhur., 46: 673-6(1961). 12p.

The investigation was conducted on Elodea canadensis and Chlorella pyrenoidosa using heavy-oxygen water of 17 and 23% enrichment, respectively. The plants were: I. exposed to heavy-oxygen water and light; II. exposed to heavy-oxygen water and darkness; and III. ordinary water and light. The violaxanthene was extracted from the plants and exposed to protons to convert the incorporated O^{18} to F^{18}. The F^{18} was detected in I., and not detected in II. and III.; thus indicating that light causes the plant to take up the O^{18} and incorporate it in the violaxanthene. (B.O.G.)

2879 DISTRIBUTION OF RADIOACTIVE PHOSPHORUS IN HEAT-KILLED BACTERIA. Antonina Guelin and Pierre Lepine (Institut Pasteur, [Paris]). Ann. inst. Pasteur, 101: 677-86(Nov. 1961). (In French)

In previous studies the nonmetabolic fixation of radiophosphorus by killed bacteria was demonstrated. These findings suggest not only the adsorption of P^{32} on the surface of these bacteria, but also its penetration into the bacterial cytoplasm through simple diffusion. The possibility of transfer of P^{32} ions inside the bacterial cytoplasm denatured by heat was studied. The study of four fractions containing P, extracted from heated germs labelled with P^{32}, confirms the penetration of P^{32} ions inside non-viable bacteria and their affinity for nucleic acids. (auth)

2880 NEUTRON CAPTURE THERAPY OF A CEREBELLAR HEMANGIOSARCOMA AFTER SURGICAL AND

RADIATION TREATMENT. Lee E. Farr and Lucas Y. Yamamoto ([Brookhaven National Lab.], Upton, N. Y.). J. Nuclear Med., 2: 253-71(Oct. 1961). (BNL-4883)

A patient with a highly malignant vascular sarcoma of the cerebellum was treated by neutron capture therapy. Almost complete elimination of the neoplasm was attained. Other than the skin, normal tissues about and within the neoplastic mass did not appear to be adversely affected. An unusual and unexpected bulbar conjunctivitis was observed as a complication. The degree of control attained by this experimental procedure was more positive than that previously attained by surgery or conventional x-ray therapy. This is the first attempt to control an intracranial tumor other than glioblastoma multiforme by this procedure. The patient is noteworthy for the extreme retention of carbon dioxide, 60 milli-equivalents per liter in the blood, apparently resulting from functional disturbances of the respiratory center. (auth)

2881 RENAL SCINTISCANS IN THE DIAGNOSIS OF RENAL VASCULAR DISEASE. Thomas P. Haynie, Bruce H. Stewart, Mohammed M. Nofal, Edward A. Carr, Jr., and William H. Beierwaltes (Univ. of Michigan Medical Center, Ann Arbor). J. Nuclear Med., 2: 272-81(Oct. 1961).

Renal scintiscans using Hg^{203}-labeled Neohydrin and photoscanning were demonstrated to show segmental infarction in the dog kidney in vivo. Renoscans performed with Hg^{203}-Neohydrin correctly predicted the operative findings in a high percentage (80%) of 14 surgically documented cases of renal vascular disease in hypertensive patients. The ranking of renal scintiscans with other procedures in order of decreasing accuracy in detecting renal vascular disease was aortograms, Hg^{203}-Neohydrin renoscans, renograms, pyelograms, Howard test, and I^{131}-Hippuran renoscans. Renoscans proved particularly useful in evaluating the functional state of renal tissue distal to arterial lesions, detecting small areas of viable tissue, and in revealing space-occupying lesions. I^{131}-Hippuran renal scintiscans were disappointing. The addition of anatomic information to the radioisotope procedure in the evaluation of renal vascular disease patients proved fruitful in a small series of cases and deserves further application. (auth)

2882 PRACTICAL APPLICATION OF NEUTRON ACTIVATION ANALYSIS FOR THE DETERMINATION OF PROTEIN BOUND METALS IN BLOOD SERUM. A. Jacobson, S. Brar, T. Fields, I. G. Fels, E. Kaplan, P. Gustafson, and Y. T. Oester (Veterans Administration Hospital, Hines, Ill. and Argonne National Lab., Ill.). J. Nuclear Med., 2: 289-96(Oct. 1961).

The essentially complete removal of sodium, potassium, and chlorine was achieved. Complete retention of protein was maintained. Ion exchange separation techniques which were tried were notably poor in this instance because of loss of protein on the ion-exchange column. Untreated, undialyzed, blood serum spectrum was observed to have a high Na^{24} background as contrasted to the treated (dialyzed) blood serum spectrum. Counts from Cu^{64} and Mn^{56} standards were in the 5-20000 cpm range and accuracies of ±10% were estimated for each individual sample. Mn^{56} samples were counted shortly after irradiation because of the relatively high activity as compared to Cu^{64} which could be counted the following day. Results of tests performed on the serum of normal patients by this procedure yielded the expected values of approximately 2μg/ml serum for copper and 0.1μg/ml serum for manganese. (auth)

2883 A THEORETICAL EVALUATION OF BRAIN SCANNING SYSTEMS. Robert N. Beck (Univ. of Chicago). J. Nuclear Med., 2: 314-24(Oct. 1961).

Under certain conditions, it appears that focusing collimator systems can be designed for .511 Mev radiation which are superior to coincidence systems by factors of 2 to 10 (depending on resolution) for midline tumors. These factors increase for tumors not on the midline. Making the further assumption of equal numbers of photons produced/cm^3-sec for all systems, the figure of merit for focusing collimator systems increases with decreasing gamma energy down to 200 Mev, the low energy limit of this investigation. Therefore it is generally concluded that the advantages of low energy gamma radiation for brain scanning have not yet been fully exploited. (auth)

2884 RASPREDELENIE NEKOTORYKH RADIOAKTIVNYKH ELEMENTOV V ORGANIZME ZHIVOTNYKH. (POLONIYA-210, RADIOTORIYA-228, PLUTONIYA-239, I STRONTSIYA-90). ATLAS. (Distribution of some Radioactive Elements in Animal Organisms (Polonium-210, Radiothorium-228, Plutonium-239, and Strontium-90). Atlas). E. V. Erleksova. Moscow, Medgiz, 1960. 150p.

Descriptions are given of autoradiographic studies of tissues and techniques of autoradiography and histoautoradiography in investigations of localized α emitters in organisms. Localization of Po^{210}, $RdTh^{228}$, Pu^{239}, and Sr^{90} incorporated by various means and in various amounts is discussed, and autoradiograms and historadiograms are included. 90 references are included. (R.V.J.)

Radiation Effects on Living Tissues

2885 (A/AC.82/G/L.620) RITMIKA OKISLITEL'NYKH PROTSESSOV I EE NARUSHENIE PRI DEISTVII RADIATSII. (The Rhythm of Oxidization Processes and its Disturbance Under the Action of Radiation). G. M. Frank and A. D. Snezhko (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). Aug. 28, 1961. 21p.

A modified polarographic method has been developed to determine continuously variations in the oxygen content of tissue by inserting a platinum needle as an electrode directly into the tissue of a living animal. The "oxygen test," in which the animal is allowed to breathe a controlled amount of pure oxygen, gives information about the rate of utilization of oxygen by the tissue. Ordinarily the increase in the oxygen diffusion current ΔI is stable in form and amplitude for any given experimental animal and for a given location of the electrode. Thus, after a total irradiation of 700 to 1000 r, the value of ΔI increased by a factor of two. A decrease in the ability of tissue to utilize oxygen after irradiation is indicated. Local irradiation gives a low value of ΔI, and indicates that the unirradiated cells utilize oxygen at a faster rate than before irradiation. The oxygen content of the tissue was observed to vary rhythmically with two periods. One rhythm had a small amplitude and a high frequency of 15 to 20 oscillations per minute, and the other rhythm had a large amplitude and a low frequency of 2 to 3 oscillations per minute. Irradiation leads to a suppression of this rhythmic oscillation in the oxygen content of the tissue. These effects are most readily apparent in the irradiation of growing rootlets (Vicia fabia) and of a multiplying yeast culture. This method sheds some light on the course of chemical processes such as oxidation that occur in the cell as a function of the period of time after irradiation. (TTT)

2886 (A/AC.82/G/L.625) O NEKOTORYKH PROBLEMAKH SOVREMENNOI RADIOBIOLOGII. (Certain Problems of Modern Radiobiology). A. V. Lebedinskii and Yu. I. Moskalev (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). Aug. 28, 1961. 18p.

It is believed that the mutation of somatic cells is the result of chromosome damage by radiation which affects the synthesis of some vital protein which changes the reduplication properties of DNA and results in mutants. Chromosomal material is very sensitive during the moment of condensation, and 8 to 10 rads can stop the division at this time. The cell is particularly radiosensitive during periods of mitotic activity. Thus, "old" cultures of bacteria show a lowered sensitivity to radiation, while growing cancer cells are more radiosensitive than normal cells. Nerve tissue is highly sensitive to radiation. The effects of small doses of radiation administered internally have been shown to be additive. Regenerative processes can also occur. The stimulating effects of ionizing radiation are reviewed. It is thought that the origin of cancerous growths by irradiation may be due to cell mutation. The occurrence of osteosarcoma and leukemia by injection of Sr^{90} is discussed. The additiveness of irradiation dose can be observed in the incidence of cancer. A number of the effects of ionizing radiation can be detected at small doses. One of the important conclusions of the review is the recognition that a living organism lacks the ability to adapt itself to the action of ionizing radiation. 58 references. (TTT)

2887 (A/AC.82/G/L.636) EKSPERIMENTAL'NOE IZUCHENIE PERVICHNOGO MEKHANIZMA DEISTVIYA RADIATSII NA YADRO KLETKI. (An Experimental Study of the Primary Mechanism of the Effects of Radiation on Cell Nuclei). N. P. Dubinin, B. N. Sidorov, N. N. Sokolov, and M. I. Mekshenkov (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). Aug. 28, 1961. 31p.

The dose required to obtain a given effect on a dry material is much greater than the dose required to obtain the same effect in aqueous solution. An indirect effect of radiation is caused by the radiolysis of water to form OH and HO_2 radicals which react with the substrate. Free radicals can be produced with the use of radiation by reacting ferrous iron with H_2O_2 (Fenton's reagent) and by reacting ascorbic acid with H_2O_2. By immersing onion bulblets in 0.001 M $FeSO_4$ or 0.001 M ascorbic acid followed by immersion in 0.01 M H_2O_2, a powerful mutagenic effect was observed in that 17.7% chromosome rearrangements were observed with the use of Fenton's reagent. The percentages were 11.8% with the use of ascorbic acid plus H_2O_2, 1.8% for $FeSO_4$ alone, 1.7% for ascorbic acid alone, 1.9% for water alone, and 5.8% for H_2O_2 alone. The addition of KI to a ferric system resulted in a reduction of Fe^{3+} to Fe^{2+}. Free radicals were then formed by treatment with H_2O_2, and a mutagenic effect could be detected (37.4% chromosomal rearrangements). It was found that iodide and bromide ions react with the free radicals produced by Fenton's reagent and by the reaction of ascorbic acid with H_2O_2, and decrease the mutagenic effect of these free radicals. Hydroquinone, quinone, hyposulfite and thiourea were also effective. However, these protective reagents do not protect the cells against genetic damage on irradiation with x-rays. Hence, the genetic effect of radiation is primarily due to the direct effect of a quantum of energy on the chromosome. However, it is pointed out that protective reagents may play an important role in decreasing the indirect effects of radiation by combining with free radicals, especially in dilute solutions. 87 references. (TTT)

2888 (A/AC.82/G/L.637) NEKOTORYE VOPROSY EKSPERIMENTAL'NO-BIOLOGICHESKOGO OBOSNOVANIYA MAKSIMAL'NO-DOPUSTIMYKH KOLICHESTV RADIOAKTIVNYKH IZOTOPOV PRI POPADANII IKH V ORGANIZM. (Certain Questions Involved in Determining the Maximum Permissible Quantities of Absorbed Radioisotopes by Means of Biological Experiments). M. G. Durmish'yan (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). Aug. 28, 1961. 15p.

The factors determining the relative danger of radiation are the energy of the emitter, the half-life of the radioactive isotope, the biological half-life in the organism, the path of entry into the organism, the distribution in the organism, the sensitivity and reactivity of the tissue to radiation, the total sensitivity of the organism to radiation, the particular sensitivity of the organism to radiation, the age of the tissue, the latent period of biological "chain" processes, and remote effects which include the genetic effects. The biological or "organic" effects are difficult to evaluate as compared to the physical effects. The biological half-life of Na^{24} can be decreased by injecting stable sodium in the form of NaCl or Na_2CO_3, and the beneficial results of this treatment can be seen in measurements of the time of synapic conductivity for a typical unconditional reflex. However, the additional dose to the bladder must be taken into account. Penetration of a radioactivity into an organism by way of the lungs is particularly dangerous because of the large number of receptors in the lungs, as can be seen by the difference in tolerance doses for the same isotope in water as compared to its tolerance dose in air. Since damage to the receptors in one organ can have an adverse effect on the function of another organ, the concept of the "critically important organ" must be carefully examined. The effect of small internal doses of Na^{24} on the radiosensitivity of various tissues has been investigated. Thus, the threshold dose for rabbits (3 kg) was found to be 5 mc of Na^{24} for the total serum protein, 1.0 mc for residual nitrogen, 1.0 mc for cholinesterase, 0.25 mc for stimulation of leukocytes and 1.0 mc for Na^{24} for suppression of leukocytes. Measurement of the reflex time has been found to be a sensitive indicator of the effect of radiation. (TTT)

2889 (A/AC.82/G/L.639) O NACHAL'NYKH MEKHANIZMAKH BIOLOGICHESKOGO DEISTVIYA IONIZIRUYUSHCHIKH IZLUCHENII. (The Initial Mechanisms of the Biological Effects of Ionizing Radiation). A. M. Kuzin (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). Aug. 28, 1961. 11p.

The initial processes occurring in a cell during the period between the irradiation of a cell and the observed biological effects of the irradiation (slow-down in mitotic activity, chromosome rearrangements, disruption in division, cell growth and decay, etc.) can be detected by the use of delicate physical and chemical tests. Polymers having a high molecular weight (simple proteins, ferments, nucleoproteins, lipoproteins, glycoproteins, polysaccharides, etc.) possess an ordered structure in the cell in the form of micelles, double membranes, granules, microsomes, mitochrondria and chromosomes. The formation of OH and HO_2 radicals in the cell by ionizing radiation leads to oxidative chain reactions which can be detected by changes in penetrability of the cell wall. Thus, wheat seedlings given a dose of 1000 r show a decrease in penetrability for Na_2HPO_4 and Na_2SO_4, and an increase in

penetrability for $FeCl_3$. Two hours after irradiation, the endothelial cells of rats given a 1000 r dose of x-rays show a decrease in ability to absorb a radioactive silver colloid. Changes in the physical properties of DNA and RNA have been frequently observed. These physical changes lead to changes in activity of various enzymes. Certain enzymes are stimulated by irradiation and others are depressed in activity. However, there generally is a suppression of the synthesis processes in the cell leading to a rapid break-up of the ordered arrangement of the cell. The appearance of anomalous metabolites has a toxic effect on the viability of the cell. Thus, irradiation of a cell leads to immediate physical and chemical changes which are followed by extensive biological effects. (55 references) (TTT)

2890 (AF-SAM-61-93) EFFECTS OF LOW-LEVEL, REPEATED EXPOSURES AND LONG-TERM CONSIDERATIONS OF IONIZING RADIATION. Gerrit L. Hekhuis (School of Aviation Medicine. Aerospace Medical Center, Brooks AFB, Tex.). May 10, 1961. 10p.

The biological effects of low-level radiation delivered as fractionated or protracted doses are reviewed. It is pointed out that since man has not yet lived in a controlled or documented radiation environment for sufficient time to allow adequate analysis and evaluation; the best we can do is to record existing data on humans and then exercise extreme care and wisdom in our interpretations. The categories of delayed effects best documented or with best supportive evidence include longevity, leukemogenesis, carcinogenesis, cataractogenesis, and genetic or congenital changes. Each of these conditions is discussed briefly. (C.H.)

2891 (TID-14095) THE USE OF RADIATION TREATMENT METHODS TO STUDY RICE GENETICS AND IMPROVE RICE VARIETIES USED IN SOUTHEAST ASIA. Progress Report No. 9. (Taiwan. Provincial Chung-hsing Univ. Coll. of Agriculture, Taichung, China). Aug. 1961. Contract [AT(30-1)-2640]. 12p.

Field notes are presented on the characteristics of a large number of wild and cultivated rice varieties from Southeast Asia and West Africa. Studies of the leaf blast resistance of many rice varieties and its hereditary transmittance are reported. X irradiation of rice seeds was found to decrease the plant height and fertility and to increase the chromosomal aberrations in the grown plants. The sterility of radioinduced mutations was also measured for a large number of rice varieties. The effects of fertilization rate on the plant characteristics were studied. (D.L.C.)

2892 (TID-14294) EFFECTS OF CRANIAL X-IRRADIATION ON PSYCHOLOGICAL PROCESSES IN RATS. Progress Report, November 15, 1960–November 15, 1961. W. J. Arnold (Nebraska. Univ., Lincoln). Contract AT(11-1)-249. 5p.

Progress is reported in studies of the effects of cranial x irradiation of rats on response to Pavlovian conditioning, learning processes, and life span. The effects of brain irradiation were compared with the effects of a corresponding radiation dose to the legs. Preliminary results indicate that brain irradiation has a detrimental effect on learning. (C.H.)

2893 THE EFFECT OF X-RAYS ON IN VITRO AND IN VIVO HAEME SYNTHESIS IN THE PERIPHERAL BLOOD OF HENS. Zbigniew Szot, Teresa Malinowska, and Edward Kowalski (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Acta Physiol. Polon., 12: 559-70(1961). (In Polish)

The effect of x rays on heme synthesis in the peripheral blood of hens was investigated with the aid of $2C^{14}$-labeled glycine. This synthesis was found to increase in red cells when irradiated with 750 or 1000 r doses. On irradiation in vitro of peripheral red blood cells with doses of 0.2×10^3 to 1×10^5 r, doses of 10,000 r and higher were found progressively to inhibit heme synthesis. Aqueous extracts of various organs and serum and hemolyzates of the blood of various animals both normal and irradiated were investigated with reference to their effects on heme synthesis. The presence of serum enhanced heme synthesis in the system investigated. The results obtained are discussed. (auth)

2894 INVESTIGATIONS BY MEANS OF GENETIC RECOMBINATION ON THE MECHANISM OF LETHAL ACTION OF X-RAYS ON E. COLI K12. H. Marcovich (Institut Pasteur, [Paris]). Ann. inst. Pasteur, 101: 660-76(Nov. 1961). (In French)

The effects of x irradiation on the genetic recombination of Escherichia coli K12 HfrH were studied. X irradiation diminishes the transfer of the selected markers according to an exponential dose effect relationship. The radiosensitivity of the transfer process for a given marker is directly related to its distance to the origin of the chromosome. The transfer of the non-selected markers is not altered if they are located between the origin and the selected markers. The transfer of the markers located on the part of the chromosome opposite to the origin, is on the contrary diminished according to their distance to the selected marker. The sensitivity of the chromosome seems to be homogeneous in this respect. No other alteration of the genetic material has been detected. One cannot link the lethal effect of x rays in E. coli K12 to a dominant lethal mutation transmissible to the zygote by recombination. Most of the HfrH cells which survive to high doses (10^{-5} survivors) are normal as regards the mating ability and the sequence of the markers: some low frequency recombination mutants were isolated. F^- cells irradiated with x rays are restorable by mating with irradiated or non-irradiated HfrH cells. The experiments lack good reproducibility. Glycerol reduces by the same amount the radiosensitivity of both the transfer of the markers and the viability of the cells. (auth)

2895 INFLUENCE OF ROENTGEN IRRADIATION OF THE CENTRAL NERVOUS SYSTEM ON NUCLEIC ACIDS OF LIVER CELLS. Irena Królikowska-Prasał. Ann. Univ. Mariae Curie-Skłodowska, Lublin-Polonia, Sect. D, 15: 73-86(1960). (In Polish)

A study was made of the content of nucleic acids in the liver cells of the rat after roentgen irradiation of the central nervous system. The first group of animals received a single dose of 600 r; the second group received two doses of 600 r each in 24 hours' interval; the third group was treated with a single dose of 1200 r. The amount of nucleic acids was determined immediately after irradiation, and then after 2 hours, 24 hours, 7 days, and 21 days. The histophotometric method was applied to histological preparations; DNA and RNA were determined in liver homogenate by the method of Schneider. The results of the investigations, after statistical analysis, suggested that, after roentgen irradiation of the central nervous system of the rat, changes in the nucleic acid content of liver cells can be observed. These changes affect mainly the DNA content in the nucleus, which decreases during the first hours after irradiation with the single doses of 600 r and 1200 r, and after the repeated dose of 600 r. The decrease of the DNA content is transient. No distinct changes in the RNA content were observed. Slight variations from the control value were observed immediately after the repeated dose of 600 r.

The transient changes in the DNA content are probably the result of increased mitosis and of the scanty instances of caryorrhexis. (auth)

2896 INFLUENCE OF X-RAYS IRRADIATION OF THE CENTRAL NERVOUS SYSTEM ON THE ISLES OF LANGERHANS IN THE PANCREAS. Maciej Latalski. Ann. Univ. Mariae Curie-Skłodowska, Lublin-Polonia, Sect. D, 15: 87-90(1960). (In Polish)

After irradiation of the central nervous system with x rays, microscopic analysis of the isles of Langerhans revealed perceptible changes in those animals only which had received a single dose of 1200 r. The changes were of a rather regressive character; they were temporary, appeared about a week after irradiation, and disappeared in the following days. (auth)

2897 THE DEPENDENCE OF THE CONFIGURATIONAL STABILITY OF DEOXYRIBONUCLEIC ACID (DNA) ON ITS MOLECULAR WEIGHT (CONCERNING RADIATION-SENSITIVE AND RADIATION-RESISTANT FORMS OF DNA). V. S. Tongur, D. M. Spitkovskii, P. I. Tseitlin, and N. B. Gorkina (Inst. of Experimental Biology, Academy of Sciences, Moscow). Biophysics (U.S.S.R.) (English Translation), 6: No. 1, 5-9(1961).

By irradiation with sound waves in an atmosphere of nitrogen 13 preparations of DNA with a spectrum of molecular weights from 0.5×10^6 to 4.4×10^6 were obtained. An increased stability of the DNA to the action of sonic irradiation with decreasing level of polymerization of the DNA was noted. The most pronounced examples of this phenomenon were observed with DNA mol. wt.'s of the order of 1×10^6. It was shown that the extinction coefficient of DNA in UV light (at $\lambda = 260$ mμ) decreases with decreasing level of polymerization of the DNA. From a study of the radiation sensitivity of DNA preparations as a function of their mol. wt., it was found that DNA molecules with mol. wt. $< 1 \times 10^6$ show increased resistance to radiation. It was found that DNA preparations with mol. wt. $< 1 \times 10^6$ possess increased configurational stability toward the influence of a change in the pH of the medium. The experiments carried out confirmed to a certain degree the thesis that in solution, other conditions being equal, there are two types of DNA molecules: a contracted stable type (at mol. wt. $< 1 \times 10^6$), and an extended metastable configuration (mol. wt. $> 1 \times 10^6$). These types are distinguished by different configurational stability toward external influences which do not cause depolymerization of the molecules of nucleic acid. (auth)

2898 THE EFFECTS OF γ-RADIATION ON THE PROTEIN CONTENT OF APPLES AND PEARS. I. D. Clarke and S. J. G. Fernandes (Wantage Research Lab., Berks, Eng.). Intern. J. Appl. Radiation and Isotopes, 11: 186-9(Nov. 1961). (In English)

Apples and pears, which had received 1×10^5 rad and 2×10^5 rad γ radiation in air at 20°C, were stored with untreated fruit in air at 37 and 32°F, respectively. The pulp and peel were frozen and stored in polyethylene bottles until chemical analysis. In general, the results obtained with apple tissue indicated that protein synthesis was unaffected by the treatment. The results obtained with pear tissue clearly indicate that the treatment induced protein synthesis during the storage period, while the levels of protein nitrogen in the untreated fruit remained at a fairly steady level. (C.H.)

2899 GLUCOSE UPTAKE AND DISSIMILATION BY X-IRRADIATED, STARVED, AND DIVISION-INHIBITED YEAST. Edward Spoerl and C. W. Quiner (Army Medical Research Lab., Ft. Knox, Ky.). J. Bacteriol., 82: 764-9 (Nov. 1961).

Estimates of the relative participation of the pentose cycle and the Embden-Meyerhof-Parnas pathways in sugar dissimilation, by means of $C^{14}O_2$ recoveries from yeast cells fed specifically labeled glucose, showed significant differences indicating less pentose cycle activity in starved irradiated cells than in unirradiated cells. This result is in qualitative agreement with previously observed respiratory quotient values, which indicated greater glycolytic activity in starved irradiated cells; this implicates a change in pathways of dissimilation in the responses observed following irradiation and starvation. A concurrent lower rate of uptake of glucose from the medium was observed for unirradiated, starved cells as compared to irradiated cells. The possibility that the membrane is the site of the cellular change involved in these responses is discussed. (auth)

2900 THE INFLUENCE OF SMALL DOSES OF ULTRAVIOLET RADIATION UPON THE VARIATION OF SHIGELLA FLEXNERI. Z. G. Pershina and I. G. Vasil'eva (Gamaleya Inst. of Epidemiology and Microbiology, Academy of Medical Sciences, USSR). J. Microbiol., Epidemiol. Immunobiol. (U.S.S.R.)(English Translation), 31: 2106-10 (1960).

A high degree of resistance to streptomycin and a somewhat less marked resistance to penicillin developed rapidly in Shigella flexneri exposed to small doses of ultraviolet radiation not affecting the viability of the organisms. The streptomycin-resistant ultraviolet variants of Sh. flexneri were not different from the original strain with regard to their morphological, biochemical, serological and antigenic properties; their virulence, however, was somewhat lower. (auth)

2901 SKIN HOMOGRAFT TOLERANCE IN LONG-LIVED RADIATION CHIMERAS AND ITS ABOLITION BY INJECTED LYMPHOID CELLS. W. E. Davis, Jr. and L. J. Cole (Naval Radiological Defense Lab., San Francisco). J. Natl. Cancer Inst., 27: 1059-67(Nov. 1961).

(C57L × A) F_1 hybrid mice (LAF_1) were exposed to a lethal dose of x rays (870 r) and then received intravenous injections of mouse bone marrow cells obtained from genetically foreign normal donors (C3H strain). The mice that survived for 1 year or more after this treatment were then challenged with tail-skin grafts to evaluate their immunological state. LAF_1 and C3H-type skin grafts (corresponding to the host and the marrow donor strains, respectively) were accepted by almost all the recipients. BALB/c- or DBA/2-type skin grafts (foreign to both the host and marrow donor strains) were rejected. These long-lived mice, known to be radiation chimeras, are therefore capable of a homograft response, but are tolerant to skin grafts of host (LAF_1) or of marrow donor (C3H) geno-type. The tolerance to C3H skin grafts was abolished, and the C3H skin grafts were rejected 2 to 3 months after inoculation with lymphoid cells obtained from either normal or sensitized (anti-C3H) LAF_1 donors. Other chimeras, receiving injections of irradiated LAF_1 lymphoid tissue, maintained tolerance to the C3H skin grafts. To test for the presence of immunologically active C3H-type cells in these chimeras, cells from their lymphoid tissues were injected into sublethally irradiated (C3H × DBA/2)F_1 hybrids, and the signs of wasting and death known to follow the injection of parental strain C3H cells (but not LAF_1 cells) were observed. With this system, C3H lymphoid cells were present in the tolerant mice. In contrast, these cells were not present in the mice that were no longer tolerant to C3H grafts. (auth)

2902 INACTIVATION BY ELECTRON RADIATION OF THE CAPACITY OF GOLDENROD POLYSACCHARIDE TO INDUCE VACUOLIZATION IN ASCITES TUMOR CELLS. John W. Preiss, Morris Belkin, and Walter G. Hardy (National Cancer Inst., Bethesda, Md.). J. Natl. Cancer Inst., 27: 1115-21(Nov. 1961).

A polysaccharide from goldenrod was exposed to various doses of 7 kv electrons from a tungsten filament. The attenuation of the capacity of this polymer to induce cytoplasmic vacuolization and enlargement in Sarcoma 37 ascites tumor cells was studied. The logarithm of survival for this property was found to be a nearly linear function of electron dose, within the limits of experimental error. No negative curvature near zero dose was observed. Dose-survival curves for the inactivation of the enzymic functions of ribonuclease (mol wt 13700) and invertase (mol wt 120,000) were obtained in the same manner. A comparison with these curves leads to the conclusion that the molecular weight of the polysaccharide moiety responsible for cell vacuolization is in the order of 8000. (auth)

2903 LONG-TERM CULTIVATION IN TISSUE CULTURE OF LEUKEMIC CELLS FROM MOUSE LEUKEMIA INDUCED BY MOLONEY VIRUS OR BY X RAYS. Haim Ginsburg and Leo Sachs (Weizmann Inst. of Science, Rehovoth, Israel). J. Natl. Cancer Inst., 27: 1153-71(Nov. 1961).

Successful long-term in vitro cultures of leukemic cells were obtained from BALB/c, C57BL/6, SWR, and Swiss mice, with leukemia induced by Moloney virus; and from C57BL/6 mice, with leukemia induced by x rays. The leukemic cells were grown from 4 to 10 months in vitro. All the cell lines were successfully maintained on feeder layers of normal mouse spleen cells in Eagle's medium supplemented with horse serum. Under these conditions the leukemic cells grew free in the medium, so that they could be readily passaged without trypsinization. The leukemic nature of the cultured cells was established by examination of cell smears and by cell transplantation into animals. (auth)

2904 THE REACTION OF THROMBOCYTES (AND OF CERTAIN OTHER ELEMENTS OF THE HEMOGRAM) TO THE ACTION OF LOW DOSES OF IONIZING RADIATION DEPENDING ON THE ORGANISM'S PRELIMINARY CONTACT WITH THE LATTER. O. S. Sergel (State Scientific-Research Inst. of Roentgen-Radiology, Ministry of Health, USSR). Med. Radiol., 6: No. 9, 17-21(Sept. 1961). (In Russian)

Marked undulations of absolute values of thrombocytes, eosinophils, and monocytes observed directly after x-ray examination of the chest or the introduction of 25 μc of radioiodine in persons subjected to prolonged action of ionizing radiation are described. In non irradiated persons such changes of the blood elements are absent. The above differences are particularly demonstrable in comparative studies of the blood reaction to the effect of diagnostic doses of ionizing radiation in patients before and after radium therapy, as well as in radiologists. (auth)

2905 STUDIES OF THE CHEMICAL COMPOSITION OF THE CRYSTALLINE LENS IN RADIATION CATARACT. L. M. Luzanova and A. A. Cubakov. Med. Radiol., 6: No. 9, 21-5(Sept. 1961). (In Russian)

2906 THE EFFECT OF TOTAL IRRADIATION WITH RADIOCOBALT ON THE CONTENT OF RNA AND DNA IN THE WALL OF ANIMAL SMALL INTESTINE. P. M. Belyaev (Minsk Medical Inst.). Med. Radiol., 6: No. 9, 34-8(Sept. 1961). (In Russian)

2907 CHANGES OF TOXIC FOR PARAMECIA PROPERTIES OF BLOOD PLASMA OF RABBITS AND MONKEYS IN ACUTE RADIATION SICKNESS. G. A. K. Dzhafarov (Baku Inst. of Roentgen-Radiology and Oncology, [USSR] and Khar'kov Inst. of Medical Radiology, [USSR]). Med. Radiol., 6: No. 9, 38-45(Sept. 1961). (In Russian)

Experiments were staged on 45 rabbits, subjected to whole-body single irradiation in doses of 400, 800, 1600, 2000, and 2500 r, and on 21 monkeys irradiated in doses of 930, 837, and 744 r. It was established that 1 to 3 hours after irradiation there occurs an intensification of toxic (for Paramecium) properties of the blood plasma, which with certain undulations remains on a high level until the death of rabbits and decreases considerably prior to the death of monkeys. The greater the toxicity for Paramecium 1 and 24 hours after irradiation, the earlier the rabbits perished. Posthumous investigation of the blood plasma showed that the toxicity was more pronounced in rabbits which had succumbed during the first 6 days after irradiation. (auth)

2908 THE ROLE OF RADIATION OF RADON AND PRODUCTS OF ITS DECAY ON THE THERAPEUTIC EFFECT IN FUNCTIONAL AND INFLAMMATORY DISEASES OF THE STOMACH. R. L. Blokh (State Inst. of Physio-Therapy, Caucasus Mineral Waters, Pyatigorsk, USSR). Med. Radiol., 6: No. 9, 48-53(Sept. 1961). (In Russian)

In 232 patients suffering from functional and inflammatory diseases of the stomach, a comparative assessment of the therapeutic action of radon baths with varying concentrations of radon was carried out. Radon baths proved to be more efficacious with higher concentrations of radon. It was concluded that in the curative action of radon baths, a definite role is attributed to the radiation of radon and products of its decay. (auth)

2909 THE EFFECT OF RADIATION OF RADON AND PRODUCTS OF ITS DECAY ON PROCESSES OF BLOOD CIRCULATION. O. Yu. Volkova, A. D. Tashinskaya, and M. S. Kagan (State Inst. of Physio-Therapy, Caucasus Mineral Waters, USSR). Med. Radiol., 6: No. 9, 54-63 (Sept. 1961). (In Russian)

The effects of inhaling different concentrations of radon on the processes of hematopoiesis in white mice are discussed. (auth)

2910 EFFECT OF ULTRA-VIOLET RADIATION AND DESICCATION OF DIFFERENT AGE-CULTURES OF ESCHERICHIA COLI K12. I. L. Mulay and G. S. Sperti (Institutum Divi Thomae, Cincinnati). Nature, 192: 773 (Nov. 25, 1961).

The sensitivity of different age cultures of E. coli to u-v radiation and desiccation was studied by exposing cultures to one of the agents, incubating at 37°C for 24 hr, and counting the developed colonies relative to controls. The results indicate a minimum in resistance to the two agents occurring at the 4.5-hr-old stage, in the logarithmic phase of growth. The recovery of the resistance observed in the lag phase (0.75 hr) is complete for desiccation after 24 hr (maximum stationary phase), but not quite complete for u-v radiation. (D.L.C.)

2911 RADIOSENSITIVE STAGES IN THE SPERMATOGENESIS OF DROSOPHILA MELANOGASTER. V. A. Strangio (Univ. of Melbourne). Nature, 192: 781-2(Nov. 25, 1961).

A preliminary account is given of experiments designed to detect simultaneously complete loss of X or Y chromosomes, deletion in the Y chromosome, and non-disjunction between

X and Y chromosomes. A new, doubly marked Y chromosome stock designated sc^8YB^s is used. After x irradiation with 1,000 r, males with a wild-type X chromosome and the doubly marked Y are mated daily to three females homozygous for the X chromosome markers yellow, apricot, echinus. On the assumption that the determination of nondisjunction will occur only at or before anaphase in the first meiotic division, the results indicate that the seventh brood in particular represents treated pre-meiotic stages and confirm the high sensitivity of meiotic and immediately pre-meiotic stages to the mutagenic effect of x rays. (D.L.C.)

2912 EFFECT OF RADIATION ON HUMAN HEREDITY: INVESTIGATIONS OF AREAS OF HIGH NATURAL RADIATION. World Health Organization Technical Report Series No. 166. First Report of the Expert Committee on Radiation. (World Health Organization, Geneva). 1959. 47p. $0.30(World Health Organization).

Radiation effects on human heredity were studied. General principles were developed for investigation of high radiation areas which might apply to any part of the world. The application of these principles to a specific situation, Kerala State and part of Madras State, India is described. A survey is presented of known areas of high-background radiation. Suggestions for information which should be collected in a Kerala project are outlined. (M.C.G.)

Radiation Sickness

2913 (NP-10713) OCHRONA RADIOLOGICZNA W MEDYCYNIE. (Radiological Protection in Medicine). Jerzy Pensko (Poland. Biuro Pelnomocnika Rzadu do Spraw Wykorzystania Energii Jadrowej, Warsaw). 1961. 133p.

A review of radiological protection theory and systems, directed toward medical considerations is given. Examples of the types of radioactive materials and types of radiation to which humans might be exposed, the phenomena of energy loss by these types of radiation, and the effects of these transfers of energy in humans, in animals, and in matter in general, are discussed. The present limits (1961) for dose rates and exposures, under various conditions, to the several types of radiation are categorized. The shielding effects of some materials are tabulated; the data for x radiation are prevalent. Arrangement of equipment and recommended procedures for operation of x-ray devices in medical practice and diagnostic studies are described. The uses of radiation, x rays in particular, in medical therapy for various illnesses and diseases are discussed in detail. Methods of handling and disposing of radioactive wastes are presented, taking into consideration radiological protection and safety of the workers. (R.P.R.)

2914 (NP-11062) INVESTIGATIONS ON THE PROBLEM OF FORMATION AND PATHOPHYSIOLOGICAL SIGNIFICANCE OF BIOGENIC AMINES IN SUBLETHAL RADIATION INJURIES. II. ANNUAL TECHNICAL REPORT, COVERING THE PERIOD FROM OCTOBER 1, 1960 – SEPTEMBER 30, 1961. Fr. Franzen (Cologne. Universität. Medizinische Klinik). Contract DA-91-591-EUC-1573. 8p.

Investigations were carried out which furnished a specific proof of the radiation-induced formation of toxic substances. After a single short-timed total body irradiation of 400, 600, and 800 r a considerable increase of the excretion of 3-hydroxytyramine, 1-noradrenaline, adrenaline, tryptamine, 5-hydroxytryptamine, bufotenine, and histamine was observed in the urine of rats. It was also possible to prove an increase of the named aromatic amines in the blood of the irradiated rats. In a pathophysiological respect the observation of the timely correspondence between the abnormal occurrence of the biogenic amines and the development of the radiation syndrome was of a special importance. The amines found hitherto under these experimental conditions concern highly active compounds with an unusually wide spectrum of pharmacological and toxicological action. (auth)

2915 RESEARCH ON THE RADIOPROTECTION OF RADIOSENSITIZING CHEMICALS. III. ACTION OF ACETONE AND URETHAN ON THE SURVIVAL OF ANIMALS IRRADIATED IN TOTO. S. Neukomm and M. de Trey (Centre Anticancereux Romand, Lausanne, Switzerland). Bull. soc. vaudoise sci. nat., 67: 479-87(July 15, 1961). (In French)

Urethan behaves like a radiosensitizing agent in normal mice irradiated in toto when it is administered within an interval of 60 min before to 5 min after the irradiation. The duration of radiosensitization by urethan at the administered doses seems to be of about 1 hr. Acetone, in the chosen conditions, is not a radiosensitizing agent. (auth)

2916 THE USE OF BATYL ALCOHOL AND LEUKOGEN IN RADIATION LEUKOPENIA. E. N. Mozharova, A. M. Rusanov, and R. S. Komarova (Central Scientific-Research Inst. of Medical Radiology, Ministry of Health, USSR). Med. Radiol., 6: No. 9, 13-16(Sept. 1961). (In Russian)

In severe radiation leukopenia in 67 patients subjected to radium therapy, new preparations, which stimulated leukopoiesis, were employed (batyl alcohol 31 cases and leukogen 36 cases). In an almost similar contingent of patients (malignant neoplasms and lymphogranulomatosis) and almost the same total doses of irradiation the ingestion of batyl alcohol proved effective in 27 out of 31; leukogen was effective 18 of 36 cases. In radiation leukopenia in patients suffering from lymphogranulomatosis both preparations are of low effectiveness. (auth)

2917 THE PERMEABILITY OF VESSELS IN DOGS IN ACUTE RADIATION SICKNESS. P. V. Lenskaya (Central Order of Lenin Inst. of Hematology and Blood Transfusion, Ministry of Health, USSR). Med. Radiol., 6: No. 9, 26-9 (Sept. 1961). (In Russian)

With the aid of three methods (intravenous administration of fluorescein, Cr^{51} chloride, and polyglucine) the total vascular permeability was determined in dogs with acute radiation sickness after whole-body x irradiation in a dose of 600–1000 r. Phasic changes were noted in all dogs. The vascular permeability was augmented on the 1st and 2nd day after irradiation and during the peak of radiation sickness. (auth)

2918 THE CYTOCHEMISTRY OF BLOOD PLATELETS IN ACUTE RADIATION SICKNESS. A. A. Totskaya, E. I. Terenteva, and G. M. Abdullaev (Central Order of Lenin Inst. of Hematology and Blood Transfusion, Ministry of Health, USSR). Med. Radiol., 6: No. 9, 29-34(Sept. 1961). (In Russian)

The cytochemistry of blood platelets was studied at different stages of acute radiation sickness in monkeys and dogs. Acute radiation affection leads to grave functional disorders of intra platelet metabolism (in the content of cytochromoxidase, glycogen, histodin, sulfhydryl groups, lipoids, and plasmal). After the action of ionizing radiation in the thrombocytes, a sharp reduction of the levels in all the above substances, as well as changes of the nature of their localization, is noted. In a favorable issue of acute radiation sickness, a reversibility of cytochemical changes

of blood platelets is noted; the cytochemical shifts occur parallel to the regenerative processes in the thrombocytic apparatus, as well as to the disappearance of hemorrhages and thrombocytopenia. (auth)

2919 THE PREVENTION AND TREATMENT OF RADIATION SICKNESS IN EXPERIMENT. B. G. Volynskii, S. L. Freidman, K. I. Bender, K. A. Kuzmina, S. G. Kuznetsova, and L. A. Martynov. Med. Radiol., 6: No. 9, 81(Sept. 1961). (In Russian)

The effects of caffein, strychnine, morphine, uretan, quinine, diabazole, and pyrogenal on exchange processes and the central nervous system are studied. (R.V.J.)

2920 CHANGES OF PROTEIN METABOLISM IN ANIMALS WITH ACUTE RADIATION SICKNESS. I. V. Fedorov. Med. Radiol., 6: No. 9, 82(Sept. 1961). (In Russian)

The change in the metabolism of tissue proteins was studied, using the rate of S^{35} uptake in dogs irradiated with a dose of 465 r. The results showed a direct relation between weight loss and change in tissue albumen synthesis. It was shown that the biosynthesis is disturbed only during the acute stages of the radiation sickness, and the change takes place only in the blood albumen, liver tissue, and skeletal muscles. (R.V.J.)

CHEMISTRY

General and Miscellaneous

Refer also to abstracts 3309, 3310, 3311, 3312, 3313, 3314, 3315, 3316, 3317, 3335, 3336, 3337, 3338, 3339, 3340, 3341, 3349, 3351, 3352, 3353, 3354, 3355, 3356, and 3357

2921 (AD-257435) THEORETICAL INVESTIGATION OF THE ELECTRONIC ENERGY BANDS FOR THE ZIRCONIUM–OXYGEN CRYSTAL. PART I. METHODS OF INVESTIGATION. Technical Report No. 4. Stig Flodmark (Stockholm. Univ. Inst. of Theoretical Physics). Jan. 1961. Contract DA91-591-EUC-1391-OI-4357-60. 34p.

A detailed survey of investigation methods and formulas for numerical treatment of data are presented in a theoretical examination of the energy bands of Zr and Zr–O crystals. (J.R.D.)

2922 (AFOSR-1378) A THEORETICAL INVESTIGATION OF HYDROGEN-AIR REACTIONS. PART I. BEHAVIOR WITH ELABORATE CHEMISTRY. Technical Report No. 250. P. A. Libby, H. S. Pergament, and M. H. Bloom (General Applied Science Labs., Inc., Westbury, N. Y.). Aug. 1961. Contract AF49(638)-991. 57p.

A study of hydrogen-air reactions under conditions of interest related to propulsion devices was carried out. The system was idealized to result in an adiabatic, isobaric process. The temperature and composition histories for a range of initial temperatures, mixture ratios, and pressures are included. (J.R.D.)

2923 (ANL-6379) CHEMICAL ENGINEERING DIVISION SUMMARY REPORT, APRIL, MAY, JUNE 1961. (Argonne National Lab., Ill.). Oct. 1961. Contract W-31-109-eng-38. 253p.

Developments in chemical engineering are described. Pyrometallurgical development, fuel-processing facilities for EBR-II, pyrometallurgical research, laboratory and engineering-scale investigations of fluoride volatility processes, conversion of UF_6 to UO_2, calcination studies in small-diameter columns, metal oxidation and ignition kinetics, metal-water reactions, determination of nuclear constants, thermally regenerative emf cell, thermoelectricity research, reactor decontamination, waste processing, and the high-level gamma-irradiation facility are discussed. (M.C.G.)

2924 (ASD-TR-61-92) ORDERING IN OXIDE SOLID SOLUTIONS. H. H. Wilson (Clemson Coll., S. C.). Apr. 1961. Contract AF33(616)-6870. 6p.

A study was made of solid solutions formed from mixtures of magnesium oxide and either with manganese, iron, cobalt, or nickel oxide to determine if, by suitable heat treatment, ordering could be induced in certain selected compositions. Heat treatment consisted of firing the prepared solid solutions in suitable atmospheres at 200° intervals from 200 to 1200°C. The specimens were held at each temperature for 100 hrs and analyzed by x-ray diffraction to detect superlattice formation. No superlattices were found in the samples. It is possible that the lack or ordering might be due to either insufficient time at the proper temperature or to the maximum temperature being too low to allow the required ionic diffusion. (auth)

2925 (BM-RI-5892) THERMOCHEMISTRY OF ERBIUM. R. L. Montgomery and J. M. Stuve (Bureau of Mines. Reno Metallurgical Research Center, Nev.). Apr. 1961. 13p.

An investigation was conducted to check the reported heats of solution of erbium chloride, and to determine the heat of solution of erbium oxide in hydrochloric acid. The similarity between the thermochemistry of yttrium and erbium was also examined. The heats of solution and combustion of the heavier rare-earth metals and yttrium were found to be mutually inconsistent. The discrepancies may be the result of undetected or underestimated impurities. (J.R.D.)

2926 (MLM-1117) MOUND LABORATORY MONTHLY PROGRESS REPORT [ON CHEMISTRY] FOR JULY 1961. J. F. Eichelberger (Mound Lab., Miamisburg, Ohio). July 15, 1961. Contract AT-33-1-GEN-53. 12p.

Plastics Research. Izod impact strength, density, and volatiles content determinations were made on Dacron-filled diallyl phthalate molds. The characteristics of five new adhesive formulations were studied. Radioelements. Progress is reported on the development of a method for determining the coincidence correction in proportional counters. The status of the protactinium recovery project is reported. Isotope Separation and Purification. Development of processes for purifying Xe and C isotopes is discussed. Reactor Fuels and Materials Development. The interfacial tension of benzene and water as measured by the falling-drop method was found to increase with decreasing capillary size to approach the accepted value of 34 dynes/cm. Calibration of a high-temperature calorimeter for studying reactor fuel materials is discussed. The operating characteristics of an oscillating cup viscosimeter were studied. Phase studies of the Au–Pu binary system revealed only one compound, AuPu. The space group and unit cell for $CeCu_5$ were determined and found to be close to those of $CeCu_4$. Room-temperature water leach tests were conducted on two glass compositions containing 10 wt % PuO_2, and the results indicate the glasses to be quite stable. (D.L.C.)

2927 (TID-14227) PROGRESS REPORT [ON CHEMISTRY], OCTOBER 1961. Technical Report No. 17. (Anderson Physical Lab., Champaign, Ill.). Contract AT (11-1)-544. 11p.

Zone refinement runs were made on KCl which indicate that the purest KCl is located at the center of the boat. Distillation stills are described for purifying KCl. (D.L.C.)

2928 (TID-14259) CRYOGENIC THERMODYNAMIC STUDIES ON SOME GLOBULAR MOLECULES AND ON THE SYSTEM TETRAMETHYLAMMONIUM CHLORIDE-TETRAMETHYLAMMONIUM HYDROGEN DICHLORIDE (thesis). Shu-sing Chang (Michigan. Univ., Ann Arbor). 1961. Contract AT(11-1)-70. 143p.

Thermodynamic properties were determined at 5 to 350°K for five globular molecules: adamantine; hexamethylenetetramine; 1,3,5,7-tetramethyl-2,4,6,8-tetrathia-adamantane; 1,3,5,7-tetramethyl-2,4,6,8,9,10-hexathia-adamantane; and triethylenediamine. The transitions and crystal structure of these five compounds are discussed in detail. Thermodynamic properties of $(CH_3)_4NCl$ and $(CH_3)_4NHCl_2$ were also determined at 5 to 350°K and used to calculate the entropy change for the reaction $(CH_3)_4NHCl_2 \rightleftharpoons (CH_3)_4NCl + HCl$. The agreement of the calculated entropy with the experimental entropy to less than 0.1 e.u. supports the existence of a symmetrical $(Cl-H-Cl)^-$ ion with a single minimum potential energy

function. The thermodynamic properties of $(CH_3)_4NBr$ were determined at 5 to 350°K to examine the possibility of transitions similar to those found in $(CH_3)_4NCl$; no such transitions were observed. (D.L.C.)

2929 (UCRL-9842) HYDROBORATE CHEMISTRY (thesis). Robert Mesmer (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 31, 1961. Contract W-7405-eng-48. 133p.

A study of the kinetics of the hydrolysis of hydroborate ions (BH_4^-) as a function of pH was made by chemical analysis of the reducing capacity in basic solutions, and also by means of a flow method for following the rates in acid solutions. Activation parameters of 8 kcal/mole and −3.5 e.u. were obtained for the reaction with hydrogen ions; 21 kcal/mole and −22 e.u. were obtained for the pH-independent term in the hydrolysis rate. Deuterium tracer experiments were performed in lieu of measuring the deuterium isotope effect on the hydrolysis rates by both paths in the rate law, and also in an attempt to prepare deuterogermane. Hydroborate ion does exchange its hydrogens with the water hydrogens, but the reaction becomes significant only at high temperatures. The exchange was studied at 73.8 and 95.8°C. Below 50°C hydroborate ion is sufficiently inert toward this exchange to permit the determination of the deuterium isotope effect on rates of hydrolyses. The hydrogen-ion-dependent path in the hydrolysis shows an inverse isotope effect when deuterium is placed on the boron (deuteroborate reacts faster), and a normal effect when deuterium is placed in the solvent. More complex effects are observed for the pH-independent path in the hydrolysis. A method was developed for the preparation of deuteroborate using a high pressure of deuterium gas and solid potassium hydroborate at 400 to 540°C. Also, the equilibrium constant was measured for this reaction at 538°C. Studies on the competition between ferricyanide or As(III) with hydrogen ions for reactions with hydroborate ions suggest the existence of an intermediate such as BH_3. Proton magnetic-resonance experiments on decomposing hydroborate solutions failed to give evidence for the presence of species other than BH_4^-. Proton magnetic resonance studies on partially deuterated hydroborate give a hydrogen-to-hydrogen coupling constant of 10.7 cps. The spectra also give shifts due to deuterium, and a semiquantitative measure of the species present. (auth)

2930 (AEC-tr-4869) THE HEAT OF FORMATION OF AMMONIUM-HYDROGEN FLUORIDE. H. Schuetza, M. Eucken, and W. Naemsch. Translated for Oak Ridge National Lab., Tenn. from Z. anorg. u. allgem. Chem., 292: 293-7(1957). 8p.

Measurements were made of the calorific values during the combination of aqueous solutions of NH_3 and HF with the formation of NH_4HF_2 as well as the heat of solution of NH_4HF_2 and its heat of crystallization at 25°C. From the experimental data, the heat of formation is calculated to be −50.9 kcal/mole for crystalline NH_4HF_2 from the gaseous components which agrees well with that calculated from dissociation pressure data. (D.L.C.)

2931 (AEC-tr-4870) PHYSICOCHEMICAL INVESTIGATION OF THE SYSTEMS INDIUM CHLORIDE–CHLORIDES OF OTHER METALS. A. P. Vovkogon and Ya. A. Fialkov. Translated by Lydia Venters (Argonne National Lab., Ill.) from Zhur. Obshchei Khim., 15: 903-(1945). 11p.

Cooling curves were used to determine the phase diagrams of the systems $InCl_3-NaCl$, $InCl_3-AgCl$, $InCl_3-CdCl_2$, $InCl_3-ZnCl_2$, and $InCl_3-PbCl_2$. Compound formation was detected in only the first two systems: the compounds were $InCl_3 \cdot NaCl$ with a m.p. of 730°C and $InCl_3 \cdot 3AgCl$ with a m.p. of 373°C. The observed eutectic m.p.'s were 316°C for $InCl_3-NaCl$; 369 and 329°C for $InCl_3-AgCl$; 476°C for $InCl_3-CdCl_2$; 276°C for $InCl_3-ZnCl_2$; and 374°C for $InCl_3-PbCl_2$. (D.L.C.)

2932 (NP-tr-812) THE CALCULATION OF THERMODYNAMIC FUNCTIONS OF A HIGH-TEMPERATURE AIR CARBON MIXTURE. V. L. Sergeev. Translated by V. Beak (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 4: No. 4, 16-24(1961). 19p.

Concentrations of the components of an air–carbon mixture for pressures of 1, 50, and 150 atm and temperatures from 8000 to 30,000°K were calculated. Density, enthalpy, entropy, and heat capacity were also calculated. An *is*-diagram of an air–carbon mixture was constructed. (auth)

2933 (UCRL-Trans-525(L)) THERMODYNAMIC DECOMPOSITION OF GLYCOLDINITRITE. B. N. Kondrikov. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore) from Zhur. Fiz. Khim., 32: 1175-6(1958). 5p. (Includes original, 2p.).

The dissociation of the dinitrite of ethylene glycol was investigated. The kinetics of the decomposition in the gas phase were studied by measuring the pressure in a statistical system by a glass manometer of the Burdon type at 150 to 190°C. The gaseous products of the decomposition were analyzed by distillation at low temperatures and pressures and by absorption of separate components. The dependence of the volume of final decomposition products, noncondensing at different temperatures, on the initial pressure of the dinitrite was determined. (M.C.G.)

2934 (UCRL-Trans-741) ON SOLUTIONS OF THE ALKALI METALS IN LIQUID AMMONIA. NOTE IV. SPECTROSCOPIC AND PHOTOCHEMICAL MEASUREMENTS, X-RAY DIFFRACTION. Leonello Paoloni. Translated by Margaret Little (Univ. of California Lawrence Radiation Lab., Berkeley) from Gazz. chim. ital., 91: 518-28(1961). 21p.

Work done on the spectral, photoelectric, photochemical, and structural properties of solutions of Li, Na, and K in liquid NH_3 is critically reviewed in detail. (D.L.C.)

2935 NEW DATA ON THE BEHAVIOR OF ZIRCONIUM AND HAFNIUM OXYNITRATES IN AQUEOUS SOLUTIONS AND ORGANIC SOLVENTS. L. I. Yuranova, L. N. Komissarova, and V. E. Plyushchev (Moscow Inst. of Fine Chemical Tech.). Doklady Akad. Nauk S.S.S.R., 140: 855-8(Oct. 1, 1961). (In Russian)

The pH, electrical conductivity, density and viscosity of nitrate solutions of Zr and Hf were determined at concentrations varying from 0.001 to 1.0 M MeO_2. The salts used were $ZrO(NO_3)_2 \cdot 2H_2O$, $ZrO(NO_3)_2 \cdot 6H_2O$, and $HfO(NO_3)_2 \cdot 2H_2O$, $HfO(NO_3)_2 \cdot 6H_2O$. The results show that the pH decreases and the electrical conductivity increases with increasing concentration of Zr or Hf. The increase in hydrogen ion concentration is accompanied by an increase in electrical conductivity. An increase in temperature accelerates the hydrolysis process. The density and viscosity of the nitrate solutions at 20°C increase almost linearly with increasing concentration of Zr and Hf. The solubility of Zr and Hf oxynitrates in 15 organic solvents was determined by agitating an excess of the solid with 30 to 50 ml of solvent. The solubility was highest in polar organic solvents such as methyl alcohol, ethyl alcohol and acetone (about 20 wt % MeO_2). The dihydrate was somewhat more soluble than the hexahydrate. It was found that the oxynitrates of Zr and Hf did not dissolve in acetophenone, dibutyl and benzyl ether, chloroform, carbon tetrachloride, and dichlor-

ethane. The zirconium oxynitrate compounds are more soluble in organic solvents than the corresponding hafnium compounds under similar conditions. (TTT)

2936 RESEARCH WITH THE STABLE ISOTOPES OF OXYGEN (O^{17} AND O^{18}) DURING 1958-1960. D. Samuel and F. Steckel (Weizmann Inst. of Science, Rehovoth, Israel). Intern. J. Appl. Radiation and Isotopes, 11: 190(Nov. 1961). (In English)

A supplement is presented to Bibliography of the Stable Isotopes of Oxygen (O^{17} and O^{18}) by D. Samuel and F. Steckel, Pergamon Press, London (1959). It lists all papers published on the subject during the year 1958 and 1959. A Subject Index and an Author Index are included. (C.H.)

2937 INFRA-RED ABSORPTION STUDIES OF THE AQUEOUS CYANIDE COMPLEXES OF MERCURY, CADMIUM, AND ZINC. R. A. Penneman and L. H. Jones (Los Alamos Scientific Lab., N. Mex.). J. Inorg. & Nuclear Chem., 20: 19-31(Nov. 1961). (In English)

Characteristic infrared absorption was observed for several aqueous cyanide and mixed ligand complexes of mercury, cadmium, and zinc. Characteristic absorption maxima in aqueous solution are: $Hg(CN)_4^{2-}$, 2143 cm^{-1}, ϵ = 113 $mole^{-1}$ l cm^{-1}; $Hg(CN)_3^-$, 2161 cm^{-1}; $Hg(CN)_2OH^-$, 2180 cm^{-1}; $Hg(CN)_2Cl^-$, 2189 cm^{-1}; $Hg(CN)_3Cl^{2-}$, ~2157 cm^{-1}; $Cd(CN)_4^{2-}$, 2140 cm^{-1}, ϵ = 75 $mole^{-1}$ l cm^{-1}; $Cd(CN)_3^-$, 2148 cm^{-1}; $Cd(CN)_2Cl^-$, 2147 cm^{-1}; $Cd(CN)_3Cl^{2-}$, 2145 cm^{-1}, and $Zn(CN)_4^{2-}$, 2149 cm^{-1}, ϵ = 113 $mole^{-1}$ l cm^{-1}. Contrary to the interpretation of a polarographic study involving $Cd(CN)_4^{2-}$ in excess KCN, no infrared evidence for formation of $Cd(CN)_6^{4-}$ was found. Direct infrared determination of the constant for equilibrium involving the di, tri, and tetracyanide mercuric complexes gave the value, K = 0·1 = $[Hg(CN)_2][Hg(CN)_4^{2-}]/[Hg(CN)_3^-]^2$. This equilibrium was also observed qualitatively in anhydrous HCN and in CH_3OH. Concentrated solutions of $Hg(ClO_4)_2$ containing low CN/Hg ratios (0·1 to 1·2) showed infrared absorption from three species, two of which are shown to involve previously unknown polymeric species containing more than one metal ion per ligand. (auth)

2938 THE $La_xBa_{1-x}TiO_3$ SYSTEM. W. D. Johnston and D. Sestrich. J. Inorg. & Nuclear Chem., 20: 32-8 (Nov. 1961). (In English)

The system $La_xBa_{1-x}TiO_3$ was examined over the complete range of lanthanum substitution ($0 \leq x \leq 1$). Throughout most of the composition range the unit cell is cubic with the lattice parameter decreasing with lanthanum content. At the composition $LaTiO_3$ the symmetry is orthorhombic. The thermoelectric power of this system was found to be negative throughout and decreases in magnitude with the lanthanum content. (auth)

2939 PHASE EQUILIBRIA IN THE SYSTEMS NaF–PuF_3 AND NaF–CeF_3. C. J. Barton, J. D. Redman, and R. A. Strehlow (Oak Ridge National Lab., Tenn.). J. Inorg. & Nuclear Chem., 20: 45-52(Nov. 1961). (In English)

Phase equilibrium relations in the system NaF–PuF_3 were determined by thermal analysis and microscopic examination of the slowly-cooled fused mixtures. This system was investigated because of interest in possible use of mixtures in the systems NaF–BeF_2–PuF_3 and NaF–LiF–BeF_2–PuF_3 to fuel a molten fluoride power reactor. Previous studies indicated that the solubility of PuF_3 in such mixtures at proposed reactor operating temperatures is adequate for reactor designs currently under consideration. A similar study of the NaF–CeF_3 system carried out in conjunction with the NaF–PuF_3 study served to test high-temperature thermal analysis apparatus, which is discussed. It also provided data needed to complete a phase diagram based on earlier studies of the system in this Laboratory. The NaF–PuF_3 system was found to have one eutectic composition containing about 24 mole % PuF_3 melting at 727 ± 3°C and one compound, $NaF \cdot PuF_3$, melting incongruently at 842 ± 3°C. Similarly, the NaF–CeF_3 system was found to have one eutectic composition containing about 28 mole % CeF_3 melting at 726 ± 3°C and one compound, $NaF \cdot CeF_3$, melting incongruently at 810 ± 10°C. (auth)

2940 SODIUM–POTASSIUM NIOBATES AND TANTALATES. J. H. Kennedy (E. I. du Pont de Nemours & Co., Wilmington, Del.). J. Inorg. & Nuclear Chem., 20: 53-7 (Nov. 1961). (In English)

A mixed alkali metal niobate, $Na_4K_4Nb_6O_{19} \cdot 9H_2O$ and a tantalate, $Na_3K_4Ta_6O_{19} \cdot 10H_2O$ were isolated by crystallization from sodium hydroxide–potassium hydroxide solutions. Their compositions were determined by chemical analyses, and their existence as well-defined phases was demonstrated by phase plots and powder diffraction patterns. It was possible to achieve a partial separation of niobium from tantalum by taking advantage of the difference between the precipitation rates of the respective salts. (auth)

2941 THE REACTION OF UF_4 WITH OXYGEN. C. J. Mandleberg and D. Davies (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. & Nuclear Chem., 20: 58-61(Nov. 1961). (In English)

UF_6 is a product of the reaction of UF_4 with dry oxygen above 600°C and at 800°C the dominating reaction appears to be $2UF_4 + O_2 = UF_6 + UO_2F_2$. The over-all reaction is more complicated that this: U_3O_8 is also formed, and possibly U_4F_{17}. Thermal decomposition of the UO_2F_2 may also take place. In glass and silica, hydrolysis caused by residual moisture reduces the amount of UF_6 which can be isolated. (auth)

2942 A VAPOUR-PRESSURE STUDY OF THE SOLUTION OF ANTIMONY IN LIQUID ANTIMONY (III) IODIDE – THE FORMATION OF Sb_2I_4. B. L. Bruner and J. D. Corbett (Ames Lab., Ames, Iowa). J. Inorg. & Nuclear Chem., 20: 62-5(Nov. 1961). (In English)

The vapor pressure of liquid SbI_3 in the range 260–405° is given by $\log P_{mm} = -2504.5_3/T - (2.800 \times 10^5)/T^2 + 7.2119$. The decrease in vapor pressure of SbI_3 on equilibration with solid metal is in good agreement with that calculated from metal solubilities for the formation of an ideal solution of Sb_2I_4 in SbI_3, confirming the conclusions of an earlier electromotive force investigation of the same system. Values of 13.4 and 10.0 kcal for ΔH^0_{300} and ΔF^0_{300}, respectively, are calculated from the metal solubilities for the solution reaction $4SbI_{3(l)} + 2Sb_{(s)} = 3Sb_2I_{4(l)}$; corresponding quantities of −51 and −30 kcal $mole^{-1}$ are estimated for the formation of the unstable $Sb_2I_{4(l)}$ from $I_{2(g)}$ and $Sb_{(s)}$. Reduction of $SbI_{3(g)}$ at about 300 mm and 360–480° by the metal could not be detected by vapor density measurements. (auth)

2943 AQUEOUS SYSTEMS AT HIGH TEMPERATURE. I. THE COMPOUND $CuO \cdot 3UO_3$. James S. Gill and William L. Marshall (Oak Ridge National Lab., Tenn.). J. Inorg. & Nuclear Chem., 20: 85-90(Nov. 1961). (In English)

A double oxide of uranium and copper was found to exist at 300° in the four-component system UO_3–CuO–SO_2–H_2O. The most probable composition for this new compound was shown to be $CuO \cdot 3UO_3$. It was observed to be thermally stable to somewhat above 830°. The method of preparation, analysis, and some characterization of the compound are given. (auth)

2944 A STUDY OF TRANSFERENCE AND SOLVATION PHENOMENA. V. SODIUM CHLORIDE IN WATER AND WATER-ETHANOL SOLVENTS. J. O. Wear, C. V. McNully, and E. S. Amis (Univ. of Arkansas, Fayetteville). J. Inorg. & Nuclear Chem., 20: 100-5(Nov. 1961). (In English)

Transference and solvation phenomena for the ions of sodium chloride in water and water–ethanol solvents were studied. The transference numbers of the cation as a function of salt concentration in water and as a function of solvent composition are presented graphically and discussed in relation to relative solvation and ion triplets of the sodium and chloride ions. Also presented graphically and discussed is the solvent transferred from anode to cathode. (auth)

2945 THE BEHAVIOUR AND STRUCTURE OF URANYL NITRATE IN ORGANIC SOLVENTS. I. THE STUDIES OF URANYL NITRATE HEXAHYDRATE ORGANIC SOLUTIONS BY CONDUCTIVITY METHOD. B. Jezowska-Trzebiatowska and M. Chmielowska (Wroclaw Univ., Poland and Structural Research Inst. of Physical Chemistry, Polish Academy of Sciences, Wroclaw). J. Inorg. & Nuclear Chem., 20: 106-16(Nov. 1961). (In English)

From electric conductivity measurements of uranyl nitrate hexahydrate solutions in solvents of dielectric constants ranging from 7 to 109 (TBP, methylisobutylketone, methylethylketone, acetone, acetylacetone, ethanol, methanol, acetonitrile, water, and formamide) the dissociation constants were calculated for this salt. These constants are of order of 10^{-11} (in TBP) to 10^{-1} (in formamide). It was found that within a certain concentration range the uranyl nitrate forms triplet-ions $UO_2(NO_3)_3^-$ with dissociation constants of the order of 10^{-9} to 10^{-2}. Bjerrum's parameters a were calculated as well. Their very low values pointed to the presence of covalent binding between uranyl and nitrate. Therefore the values of the a parameter only allow one to draw qualitative conclusions. By using Gilkerson's derivation of the dissociation constant, the solvation of uranyl nitrate in organic solvents was examined. In several solvents the energy of solvation has the same value and the water and solvent molecules compete in the primary solvation shell. In strongly polar solvents the water molecules in the solvation shell are completely substituted by solvent molecules forming a stable complex species. The parameter a was now calculated on the basis of Gilkerson's relation for several solvents giving a constant value 2.1 Å. (auth)

2946 HYDROCHLORIC ACID PROMOTED HYDROLYSIS OF TRI-n-BUTYL PHOSPHATE. A. S. Kertes and M. Halpern (Hebrew Univ., Jerusalem). J. Inorg. & Nuclear Chem., 20: 117-26(Nov. 1961). (In English)

The study revealed that the fundamental reaction in the hydrolysis of tri-butyl phosphate accelerated by hydrochloric acid is the cleavage of the O-C linkage, and it is shown that the dealkylation reaction in the organic phase yields butyl chloride and acid esters. First-order rate constants were calculated and compared with those for a similar nitric acid system. A mechanism for the acidolytic degradation, based on the new data, is proposed. Previous observations of a greatly increased rate of hydrolysis of the organic phase as its water content increases were confirmed, and the differences in rate in parallel nitric and hydrochloric acid systems explained accordingly. (auth)

2947 ACTINIDE NITRATE SPECIES IN XYLENE SOLUTIONS OF TRI-n-OCTYLAMINE. W. E. Keder, J. L. Ryan, and A. S. Wilson (General Electric Co., Richland, Wash.). J. Inorg. & Nuclear Chem., 20: 131-9(Nov. 1961). (In English). (HW-SA-1948)

The ionic species of the tetra- and hexavalent actinides that are extracted from nitric acid by tri-n-octylamine-xylene solutions were identified as $M(NO_3)_6^{2-}$ and $MO_2(NO_3)_3^-$, respectively. The spectrum of each metal in TOA solution is shown to be nearly identical to that of an organic solution of the corresponding tetraethylammonium salt; and, in the case of the tetravalent ions, nearly identical to a concentrated nitric acid solution of the metal. (auth)

2948 THE HYDROGEN FLUORIDE SOLVENT SYSTEM. VI. THE ACID STRENGTH OF BF_3, PF_5 AND SbF_5 IN LIQUID HF. A. F. Clifford and S. Kongpricha (Purdue Univ., Lafayette, Ind.). J. Inorg. & Nuclear Chem., 20: 147-54(Nov. 1961). (In English)

The thermodynamic solvolysis constant of the BF_4^- ion in liquid anhydrous hydrogen fluoride was determined to be 7.7×10^{-3} by a method of solubility measurements. From the extensive solvolysis of its salt, it was concluded, therefore, that BF_3 was not a strong acid in liquid HF. By the same method, however, no appreciable solvolysis of the salts of PF_5 and SbF_5 in liquid HF was detected, indicating, consequently that PF_5 and SbF_5 were strong acids in liquid HF. A new method of preparation for KPF_6 and $TiSbF_6$ in liquid HF is described. The solubility product constants of $AgBF_4$, KPF_6, $KSbF_6$, and $TlSbF_6$ in liquid HF at 0°C were found to be 2.96×10^{-3}, 1.32×10^{-3}, 5.84×10^{-2}, and 2.76×10^{-4}, respectively. (auth)

2949 LATTICE ENERGIES OF THE RARER ALKALI HALIDES. M. F. C. Ladd and W. H. Lee (Battersea Coll. of Tech., London). J. Inorg. & Nuclear Chem., 20: 163-5 (Nov. 1961). (In English)

Lattice energy calculations are presented for ten alkali halides of the type Fr^+ and At^-. The terms $\Delta H_f(At^-$ gas) and $\Delta H_f(Fr^+$ gas) were evaluated from the alkali metal astatides and the francium halides, respectively, and some experimental heats of formation of these crystals were computed by an extrapolation technique. The data are tabulated. (P.C.H.)

2950 FORMATION OF COMPLEX COMPOUNDS BETWEEN URANYL NITRATE AND ALKALINE EARTH NITRATES. V. THE SYSTEM: $Ba(NO_3)_2-UO_2(NO_3)_2-H_2O$ (CONDUCTIVITY, p_h AND SPECTROPHOTOMETRY). C. S. Pande and S. S. Gupta (Univ. of Lucknow, India). J. prakt. Chem., 13: 121-6(July 1961). (In English)

Experiments such as conductivity, pH measurements, and spectrophotometry on the $Ba(NO_3)_2-UO_2(NO_3)_2-H_2O$ system revealed the existence of the following compound in solution: $Ba(NO_3)_2 \cdot UO_2(NO_3)_2$. (auth)

2951 FORMATION OF COMPLEX COMPOUNDS BETWEEN URANYL NITRATE AND ALKALINE EARTH NITRATES. VI. THE SYSTEM: $Sr(NO_3)_2-UO_2(NO_3)_2-H_2O$ (CONDUCTIVITY, p_h AND SPECTROPHOTOMETRY). C. S. Pande and S. S. Gupta (Univ. of Lucknow, India). J. prakt. Chem., 13: 127-33(July 1961). (In English)

Conductivity, pH, and spectrophotometry measurements with $Sr(NO_3)_2-UO_2(NO_3)_2-H_2O$ systems indicated that one definite complex compound is formed: $Sr(NO_3)_2 \cdot UO_2(NO_3)_2$. (auth)

2952 THE CHEMICAL STABILITY OF CARBIDES OF THE TRANSITION ELEMENTS OF THE IV, V AND VI GROUPS. V. P. Kopylova (Inst. of Metalloceramics and Special Alloys, Academy of Science, Ukrainian). Zhur. Priklad. Khim., 34: 1936-9(Sept. 1961). (In Russian)

A 0.2 g sample of carbide (270 mesh) was treated with 50 ml of solution for 24 hours in the cold and for 2 hours

on boiling. The residue was filtered, dried and weighed to determine the chemical stability. The carbides were tested with HCl (sp. gr = 1.19), 1 : 1 HCl, HNO_3 (sp. gr = 1.4), 1 : 1 HNO_3, H_2SO_4 (sp. gr = 1.84) 1 : 4 H_2SO_4, concentrated H_3PO_4, 1 : 3 H_3PO_4, concentrated $HClO_4$, 1 : 3 $HClO_4$, HCl + HNO_3 (3 : 1), H_2SO_4 + HNO_3 (1 : 1), HNO_3 + HF (4 : 1), H_3PO_4 + $H_2C_2O_4$, and H_2SO_4 + $H_2C_2O_4$. The carbides of tantalum, niobium and tungsten were more stable than the carbides of molybdenum, titanium, zirconium and hafnium. All the carbides dissolved completely in the mixture of nitric acid and hydrofluoric acid. Oxidizing mixtures such as H_2SO_4 + HNO_3 or HNO_3 + HCl were very corrosive. The carbides were found to be stable in 10% and 20% NaOH. The addition of oxidizing agents to the caustic such as bromine water, 30% H_2O_2 or $K_3Fe(CN)_6$ resulted in an increase of the amount of carbide dissolved. (TTT)

2953 THE POLAROGRAPHY OF FUSED SALTS IN A MIXTURE OF LITHIUM AND POTASSIUM CHLORIDES WITH THE USE OF A STATIONARY ELECTRODE. I. I. Naryshkin and A. E. Bazhenov. Zhur. Priklad. Khim., 34: 2102-4(Sept. 1961). (In Russian)

The electrolytic cell consisted of two crucibles filled with a eutectic mixture of LiCl and KCl and connected by a salt bridge filled with the same salt. Electrical contact was made through a very thin glass diaphragm in the wall of the salt bridge. The anode was a pool of molten lead in contact with a carbon rod protected from the fused salt by a quartz tube. A tungsten wire 0.6 mm in diameter protected by a refractory glass served as the cathode. Polarization curves were run at 450°C in the neutral electrolyte of LiCl and KCl for 0.04 to 0.24 wt % of $PbCl_2$, $CdCl_2$, $ZnCl_2$, $MgCl_2$ and NaCl. Plots of $\lg [i_k/(i_s - i_k)]$ versus the cathode polarization E(V) gave a series of straight lines for Pb, Cd, Zn, Mg and Na. The term i_k is the cathode current, and i_s is the saturation current. A plot of the saturation current i_s versus the concentration of metal in the melt gave a straight line. The half-wave potentials with respect to the chlorine electrode were found to be – 1.68 volts for Pb, – 1.81 volts for Cd, – 2.00 volts for Zn, – 3.10 volts for Mg, and – 3.22 volts for Na. (TTT)

2954 THE POLAROGRAPHY OF FUSED SALTS IN A MIXTURE OF SODIUM AND POTASSIUM CHLORIDES WITH THE USE OF A STATIONARY ELECTRODE. I. I. Naryshkin and V. M. Mogilev. Zhur. Priklad. Khim., 34: 2104-6(Sept. 1961). (In Russian)

Experiments were run at 700°C in an equimolar molten mixture of NaCl and KCl with concentrations of 0.04 to 0.15 wt % of AgCl, $PbCl_2$, $CdCl_2$ and $ZnCl_2$. Molten aluminum was used as the anode, and tungsten wire 0.5 mm in diameter was used for the cathode. Contact between the catholyte and anolyte was made through a thin glass diaphram. A plot of $\lg [i_k/(i_s - i_k)]$ versus the cathodic polarization turned out to be linear. The term i_k is the cathode current, and i_s is the saturation current. A plot of the saturation current i_s versus concentration of metal in the fused salt showed a linear relationship. The half-wave potentials with respect to a chlorine electrode were found to be – 0.97 volts for Ag^+, – 1.01 volts for Pb^{++}, – 1.19 volts for Cd^{++}, – 1.44 volts for Zn^{++}, and – 2.18 volts for the deposition of Na and K. The calculated change in valence indicates that the metallic ion is reduced to the metal. (TTT)

2955 COMBINATION OF HYDROGEN AND OXYGEN. Harold Fritz McDuffie and Charles Harold Secoy (to U. S. Atomic Energy Commission). British Patent 882,715. Nov. 15, 1961.

A method is given for combining hydrogen with oxygen to form water in aqueous solutions before sufficient amounts of the gases accumulate to form bubbles. The method comprises providing at least 0.001 M copper ions in the aqueous solutions and carrying out the combination at 150 to 450°C under superatmospheric pressures. (D.L.C.)

2956 DISSOLVING PLUTONIUM DIOXIDE. (to U. S. Atomic Energy Commission). British Patent 884,006. Dec. 6, 1961.

A method is given for the rapid dissolution of PuO_2 in HNO_3 without the use of fluoride ions or large amounts of oxidizing agents. The method comprises the addition of cerium in catalytic amounts of 0.001 to 0.02 M to the dissolving mixture and carrying out the dissolution at ~115°C or the b.p. of concentrated HNO_3. The cerium may be in either the cerous or ceric state. (D.L.C.)

2957 METHOD OF CHEMICAL DECONTAMINATION OF STAINLESS STEEL NUCLEAR FACILITIES. G. P. Pancer and J. L. Zegger (to U. S. Atomic Energy Commission). U. S. Patent 3,013,909. Dec. 19, 1961.

A chemical method is given for removing activated corrosion products on the primary system surfaces of a pressurized water reactor. The corrosion product deposits are composed chiefly of magnetite (Fe_3O_4) with small amounts of nickel and chromium oxides. The corroded surfaces are first flushed with a caustic permanganate primary solution consisting of sodium hydroxide and potassium permanganate followed by a secondary rinse solution of ammonium citrate and citric acid containing the complexing agent Versene in small amounts. Demineralized water is used to clean out the primary and secondary solutions and a 60-minute drying period precedes the rinse solution. (AEC)

2958 REMOVAL OF FISSION PRODUCTS FROM WATER. John Rosinski (to U. S. Atomic Energy Commission). U. S. Patent 3,013,978. Dec. 19, 1961.

A process is given for precipitating fission products from a body of water having a pH of above 6.5. Calcium permanganate and ferrous sulfate are added in a molar ratio of 1 : 3, whereby a mixed precipitate of manganese dioxide, ferric hydroxide and calcium sulfate is formed; the precipitate carries the fission products and settles to the bottom of the body of water. (AEC)

Analytical Procedures

Refer also to abstracts 3272, 3325, 3326, 3330, 3331, 3334, 3347, 3351, and 3849

2959 (AERE-R-3763) ANODIC STRIPPING POLAROGRAPHY USING THE CATHODE RAY POLAROGRAPH. A. P. Mead, A. Parker, and E. A. Terry (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). June 1961. 13p.

The application of the cathode ray polarograph to anodic stripping polarography is described. Two types of cells and factors influencing the efficiency of the method were investigated. Applications of the method to the determination of lead and cadmium at low levels are given. (auth)

2960 (AERE-R-3790) THE DETERMINATION OF CARBON IN PLUTONIUM METAL, ALLOYS, OXIDES AND CARBIDES. D. Crossley and G. Phillips (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Sept. 1961. 19p.

Methods are described for the determination of C in Pu metal, alloys, oxides, and carbides, together with a method for the separation of free C from combined C in the PuC. In all cases the C is converted to CO_2 by combustion at

high temperature in a stream of O. The CO_2 evolved is measured either manometrically by means of its pressure in a known volume or gravimetrically after absorption on soda asbestos. The manometric method is used for amounts of C in the range 25 μg to 2 mg with a precision (coefficient of variation) of 5% at the lower level and 1.5% at the higher level. The gravimetric method is employed for samples containing more C than can be estimated by the manometric apparatus. The precision obtainable is therefore decided by the weighing technique and for the determination of 27 mg of C is 0.5% (coefficient of variation). The free C in a sample of PuC is separated by taking advantage of the chemical reactivity of the combined C and dissolving this in C hydrochloric acid, leaving behind the uncombined C. The free C is then separated by filtration and determined manometrically after combustion to CO_2. (auth)

2961 (AERE-R-3795) THE DETERMINATION OF LEAD-210 IN HARWELL EFFLUENT. W. M. Henry and B. A. Loveridge (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Aug. 1961. 26p.

Pb^{210}, in equilibrium with lead carrier, was co-precipitated from effluent with strontium sulfate. The precipitate was metathesised to the carbonate, dissolved in dilute hydrochloric acid and the lead chloro-complex was absorbed on a column of anion exchange resin. The lead was eluted, precipitated as the chromate and β-counted after allowing time for the Bi^{210} daughter to grow in (5-day half-life). The activity of the precipitate, after corrections for chemical yield and ingrowth were made, was compared with the activity of similar sources prepared from a standardized solution of Pb^{210}. Decontamination factors at this stage were high, but improved separation from interfering nuclides could be achieved by dissolving the lead chromate in the presence of bismuth carrier and repeating the anion exchange separation. The lead fraction was rejected. The bismuth was recovered, precipitated as the phosphate, and β-counted. (auth)

2962 (ANL-6439) THE CONTINUOUS MONITORING OF BORIC ACID CONCENTRATION BY NEUTRON ABSORPTIOMETRY. Roland J. Armani (Argonne National Lab., Ill.). Oct. 1961. Contract W-31-109-eng-38. 20p.

A neutron absorption cell was built to monitor continuously the boric acid concentration of reactor water flowing through a purification loop. The instrument was calibrated over the range from 0 to 2.65 g/l with a maximum absolute error of 0.05 g/l. (auth)

2963 (IS-376) ACTIVATION ANALYSIS FOR RARE-EARTH IMPURITIES IN YTTRIUM. Kai Mow Wong and A. F. Voigt (Ames Lab., Ames, Iowa). Aug. 1961. Contract W-7405-Eng-82. 58p.

A procedure was developed for the determination of a typical rare earth, terbium, in yttrium by activation analysis. Yttrium samples containing 0.02 to 2.0% terbium impurity were analyzed, and, under the given experimental conditions, a detection limit of 0.0001% of terbium in yttrium was calculated to be possible. The sensitivity of detection may be further improved if the counting time, the thermal neutron flux, and the irradiation time were increased. Besides the extreme sensitivity of activation analysis for terbium, another favorable feature, which is of great importance in trace analysis, is the lack of interference from other contaminants during the process of chemical treatment. However, this does not mean the complete absence of interference in the method. The secondary nuclear reaction from the matrix element, contamination of sample during its preparation for irradiation, and the reproducibility of the counting of the activated product are some of the causes of errors. With little or no modification, the procedure for the determination of terbium in yttrium may be applied to the analysis of other rare earths in yttrium. Since the main difference in the procedure is in the separation step of the impurity from yttrium, a proper choice of the elution system may be made from many of the chelating agents available today for the ion exchange separation of rare earths. Some of the disadvantages of the present procedure are the comparatively long time required for the separation of the impurities from the yttrium (18 to 28 hours) and the requirement of a high thermal neutron flux for good sensitivity of detection. The first factor may be improved considerably by performing the separation at elevated temperatures and by increasing the flow rate of elution, or it may be possible to find a different and better system of eluent other than HEDTA. The second factor, disintegration rate of the activated product is proportional to the flux of the bombarding particles; a decrease of the flux would sacrifice the sensitivity of detection. The activation method is limited to the determination of those rare-earth elements which yield activities of half lives that are neither too short or too long. For example, the analysis of dysprosium or ytterbium with activated products, Dy^{165} and Yb^{177}, and half lives of 2.3 and 1.8 hours, respectively, would require an irradiation facility close to the analytical laboratory and a faster method of separation of the activities. On the other hand, the analyses for terbium, thulium, or cerium using Tb^{160} ($t_{1/2}$ = 73 days), Tm^{170} (129 days), or Ce^{142} (33 days) would require a long irradiation of the order of days to produce sufficient activities. Although difficulties are still encountered in the method, which are partly experimental and partly intrinsic in nature, it is demonstrated that the sensitivity of activation analysis for the determination of rare earths in yttrium can far surpass other analytical methods. (auth)

2964 (PG-Report-229(2nd Ed.)) ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF BORON IN URANIUM DIOXIDE POWDER AND SINTERED URANIUM DIOXIDE PELLETS. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England and United Kingdom Atomic Energy Authority. Engineering Group, Springfields, Lancs, England). 1961. 8p.

Sintered uranium dioxide pellets, ignited to U_3O_8, and uranium dioxide powder without pretreatment are dissolved in sulfuric acid in the presence of hydrogen peroxide. Boron is separated by distillation as methyl borate and determined absorptiometrically as rosocyanine. The range of the method is 0.1 to 1.5 micrograms boron, and is applicable to uranium dioxide powder containing 0.1 to 1.5 ppm boron and to sintered uranium dioxide pellets containing 0.02 to 0.3 ppm boron calculated on a uranium basis. Standard deviation (95% confidence limits) at the 0.1 to 1 ppm levels is ±10%. (auth)

2965 (PG-Report 264) ANALYTICAL METHOD FOR THE VOLUMETRIC DETERMINATION OF VANADIUM IN ORE CONCENTRATES. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1961. 5p.

Vanadium was oxidized to V^{5+} in a H_2SO_4 solution of the sample and was determined volumetrically by reduction using excess ferrous ammonium sulfate solution and back-titration of the excess with potassium dichromate solution. At the 1.5% V_2O_5 level, the precision was ±0.06%. (auth)

2966 (RMO-3001(Rev.1)) HANDBOOK OF ANALYTICAL PROCEDURES. R. W. Langridge, W. E. Bush, L. J. Higgins, and C. W. Williams, comps. and eds. (Pitkin (Lucius), Inc. Western Uranium Project, Grand Junction, Colo.). June 1, 1961. Contract AT(05-1)-776. 91p.

A handbook of analytical methods is presented. The principal types of materials for which analytical methods are given are uranium ores, uranium, and vanadium concentrates. (M.C.G.)

2967 (TID-14310) ACTIVATION ANALYSIS: NUCLEAR CHEMICAL RESEARCH; RADIOCHEMICAL SEPARATIONS; PROGRESS REPORT NO. 10, NOVEMBER 1960–OCTOBER 1961. R. S. Maddock and W. Wayne Meinke, eds. (Michigan. Univ., Ann Arbor). Nov. 1, 1961. Contract AT(11-1)-70. 165p.

Facilities. The operation of the Ford Reactor for irradiation experiments is briefly described. The design and performance of a pneumatic sample transport system ("bunny rabbit") for accelerator irradiation and subsequent counting are discussed. The modification and operation of the Texas $H^3(d,n)$ neutron generator are discussed in detail. The effects of 14.3-Mev neutrons and Co^{60} gammas on the survival of mouse fibroblast cells are summarized. Instrumentation. Various topics and problems in instrumentation are discussed briefly: pulse height analyzer, NaI(Tl) crystals, dead time recording for sample transport system, and a low-level beta counting system. Activation Analysis. A chart is presented for evaluating the relative analytical sensitivities of various elements to 14-Mev neutron activation. Results are given for activation determination of Cr, Cu, F, Fe, N, Si, O, Ag, and Na, and copper wire was analyzed for trace impurities. Nuclear Chemistry. Studies of short-lived fission gases and of the possibility of using gamma-induced short-lived isomers to monitor gamma ray fields are described briefly. Radiochemical Separations. Publication work by the Subcommittee on Radiochemistry is described. Results of work on the radiochemical separation of Cd, In, Sr, and Bi are given in detail. Data are presented for the distribution of Ag between aqueous solution and various substituted anilines and of a large number of other elements between aqueous solution and aniline. Indirect Neutron Absorptiometry. Results are given for work on the determination of K as the tetraphenylborate and of F as GdF_3 by indirect neutron absorptiometry. Instrumentation and problems involved in the neutron absorption runs are discussed, particularly the procurement of a Pu–Be neutron source. Separation Procedures. A procedure is outlined for the radiochemical separation of Sr by amalgam exchange. (D.L.C.)

2968 (AAEC/Trans-9) SALICYLIC ACID AS A REAGENT FOR THE SPECTROPHOTOMETRIC DETERMINATION OF BERYLLIUM. L. P. Adamovich and T. U. Kravchenko. Translated by H. J. de Bruin (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales) from Zavodskaya Lab., 23: 416-20(1957). 8p.

The reaction between beryllium salts and salicylic acid was studied by the spectrophotometric method in the ultra violet portion of the spectrum. The optimum pH value for this process was found to be 9.0 to 9.5. Two independent methods showed that beryllium and salicylic acid form a compound in the ratio 1:2. The instability constant was determined for a complex of the formula $(Be\ OH\ Sal_2)^{3-}$ namely $(4.9 \pm 0.6) \times 10^{-18}$. The stability of the complex and the availability of the reagents makes the reaction investigated a suitable one for analytical applications. (auth)

2969 (AERE-Trans-875) SOME REMARKS ON THE CARRIER DISTILLATION METHOD. R. Avni and M. Chaput (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Translated by F. T. Birks (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from report CEA-1908. 1961. 18p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 22243.

2970 CHRONOPOTENTIOMETRY OF CERIUM(IV). Donald G. Davis (Louisiana State Univ., New Orleans). Anal. Chem., 33: 1839-42(Dec. 1961).

The chronopotentiometry of cerium(IV) was investigated using a shielded plane platinum electrode designed to prevent disturbance of the diffusion layer by convection. The constancy of $i\tau^{1/2}/C$ was established over a concentration range of 2 to 20mM and a transition time range of 10 to 100 seconds. Errors caused by the reduction of platinum oxide films on mixtures of cerium(IV) and iron(III) were investigated. Indirect methods for the determinations of oxalic acid and arsenic(III) were developed and the kinetics of the reaction between cerium(IV) and tartaric acid were studied. (auth)

2971 SIMPLE PROCEDURE FOR CONVERSION OF OXYGEN OF ORTHOPHOSPHATE OR WATER TO CARBON DIOXIDE FOR OXYGEN-18 DETERMINATION. P. D. Boyer, D. J. Graves, C. H. Suelter, and M. E. Dempsey (Univ. of Minnesota, Minneapolis). Anal. Chem., 33: 1906-9(Dec. 1961).

A convenient procedure for the determination of the O^{18} content of KH_2PO_4 or H_2O is based on heating the samples with guanidine hydrochloride. Oxygen of water and up to two oxygens per KH_2PO_4 are converted to CO_2. The CO_2, after removal of ammonia by an H_2SO_4 trap, is used for mass spectrometer analysis. (auth)

2972 EVAPORATION OF BORON FROM ACID SOLUTIONS AND RESIDUES. Cyrus Feldman (Oak Ridge National Lab., Tenn.). Anal. Chem., 33: 1916-20 (Dec. 1961).

Volatilization of boron is slight (<3%) from solutions of H_3BO_3 in H_2O, HNO_3, H_2SO_4, and $HClO_4$ at ~75°C until very low volumes are reached. Substantial losses can occur from HCl solution earlier in the evaporation. Acidified solutions evaporated to dryness overnight on a steam bath also lose most of their boron. The presence of mannitol can prevent this loss both during and after the evaporation if the solution does not attack mannitol. Boron is volatilized from H_2SO_4 and $HClO_4$ solutions at and above 228°C, but can be retained in the system by refluxing. (auth)

2973 SPECTROPHOTOMETRIC DETERMINATION OF THORIUM WITH SOLOCHROMATE FAST RED. Johann Korkisch and G. E. Janauer (Universität, Vienna). Anal. Chem., 33: 1930-3(Dec. 1961).

A sensitive and accurate method is described for the spectrophotometric determination of microgram amounts of thorium using the azo dye Solochromate Fast Red. This dyestuff reacts with thorium in hydrochloric acid–methanol solutions to form an orange complex which shows maximum absorption at 490 mμ. Beer's law is valid over a range from 0.1 to 20 μg of thorium per ml of measuring solution. The molar absorptivity of the thorium-dyestuff complex is 13970. Only a very small number of foreign ions interfere; hence, this method can be expected to find general application, as in the determination of thorium in minerals and rocks. (auth)

2974 SPECTROPHOTOMETRIC DETERMINATION OF TRACES OF IRON WITH 4,7-DIPHENYL-1,10-PHENAN-

THROLINE. APPLICATION TO VANADIUM, CHROMIUM, TITANIUM, NIOBIUM, TANTALUM, URANIUM, TUNGSTEN METALS, ALLOYS, AND COMPOUNDS. A. R. Gahler, R. M. Hamner, and R. C. Shubert (Union Carbide Metals Co., Niagara Falls, N. Y.). Anal. Chem., 33: 1937-41(Dec. 1961).

A rapid, accurate, spectrophotometric method for the determination of iron is described. It is particularly applicable for the determination of iron in high-purity vanadium, chromium, titanium, niobium, tantalum, and tungsten metals; aluminum-vanadium alloy; titanium–aluminum–vanadium alloy; uranium monocarbide; and compounds of these metals. The method is applicable over a wide concentration range 0.0001 to about 2%. Accuracy and precision data are presented for iron at various concentration levels in different materials. A determination can be made within ½ hour after dissolution of the sample; therefore, it can be applied to control analyses. (auth)

2975 RAPID MICRODETERMINATION OF SCANDIUM AND DYSPROSIUM IN RARE-EARTH-RICH MATERIALS BY NEUTRON ACTIVATION AND GAMMA-RAY SPECTROMETRY. Minoru Okada (Government Chemical Industrial Research Inst., Tokyo). Anal. Chem., 33: 1949-53(Dec. 1961).

Activation analysis was applied to the simultaneous determination of scandium and dysprosium in rare earth-rich ores, soil, yttrium oxide, and dilute solutions containing both elements. A sample is irradiated for 30 seconds at a flux of about 4×10^{10} neutrons/sq cm/second and the induced activity is observed with a well-type sodium iodide crystal attached to a 256-channel pulse height analyzer which is operated in two steps to see the decay. The height of photopeak due to 0.142 Mev γ radiation from scandium-46m and that due to 0.108 Mev γ from dysprosium-165m are measured. Concentrations down to a few parts per million of each element can be determined. (auth)

2976 FLAME SPECTROPHOTOMETRIC STUDY OF YTTRIUM. William J. Carnes and John A. Dean (Univ. of Tennessee, Knoxville). Anal. Chem., 33: 1961-2(Dec. 1961).

The effects of oxygen and acetylene flows, ratios of these flows, different regions of flame mantle viewed, and various cations and anions on the flame spectrum of yttrium were studied. Two prominent band heads, cresting at 597 and 613 mμ, were found to be very intense, quite narrow, and only slightly degraded to the red. Only at a slit width of 0.030 mm, or less, which corresponds to a spectral band width of 1.05 mμ at 600 mμ, are the two bands resolved from each other and from the sodium line at 589.0 and 589.6 mμ. The widths of the yttrium bands at one-half the net peak height are 6 and 5 mμ, respectively. Concerning the variation of the emission intensity as a function of the ratio of oxygen flow to acetylene flow for fixed oxygen flow, the maximum emission intensity occurs when the ratio is between 3.0 and 3.8. An examination of the emission intensity as a function of the flame region viewed revealed that the region of maximum intensity occurred immediately above the inner cone. The extent to which other elements interfere with the emission intensity of yttrium from the organic aerosol is also discussed. (P.C.H.)

2977 THE EFFECT OF HEAT ON SOLUTIONS OF CERIUM(IV) SULPHATE IN SULPHURIC ACID AND SOME ANALYTICAL IMPLICATIONS. David Grant and Douglas S. Payne (The University, Glasgow). Anal. Chim. Acta, 25: 422-8(Nov. 1961). (In English)

Ceric sulfate solutions may undergo appreciable losses of cerium(IV) on heating. The over-all loss is acid dependent, being at a minimum in about 1 M sulfuric acid, and is almost independent of the cerium(IV) concentration. Consequently as the concentration falls the actual percentage loss increases. The loss, resulting from the reaction of cerium(IV) with water, is catalysed heterogeneously at the glass surface and also on the surface of any precipitated material. The extent of the loss varies considerably with the conditions of the experiment. Solutions of ceric sulfate prepared from commercial grade cerium(IV) sulfate or ceria and from spectroscopically pure ceria behave in the same fashion. The effect of added silver(I), copper(II), mercury(II), and phosphite ions in the cerium(IV)–water reaction is reported. (auth)

2978 CATION-EXCHANGE BEHAVIOR OF CALCIUM ON DOWEX 50W-X8. SEPARATION FROM MIXTURES. Santosh K. Majumdar and Anil K. De (Jadavpur Univ., Calcutta). Anal. Chim. Acta, 25: 452-6(Nov. 1961). (In English)

The cation-exchange behavior of calcium on Dowex 50W-X8 is described. Nitric acid, hydrochloric acid, ammonium chloride, sodium nitrate, ammonium acetate, and citric acid are examined as eluants. Calcium can be separated from copper(II), zinc(II), cadmium(II), mercury(II), iron(III), and from barium. Separation factors for barium–calcium and barium–strontium are evaluated. (auth)

2979 SPECTROPHOTOMETRIC DETERMINATION OF MICROGRAM AMOUNTS OF URANIUM WITH SOLOCHROMATE FAST RED. J. Korkisch and G. E. Janauer (Universität, Vienna). Anal. Chim. Acta, 25: 463-9(Nov. 1961). (In English)

A method is described for the spectrophotometric determination of micro amounts of uranyl ions with the azo dye, Solochromate Fast Red, which reacts with uranium(VI) in acetate-buffered methanol solution to form an orange-brown colored complex with maximum extinction at 490 mμ. Beer's law is obeyed over a wide range of uranium concentrations. Only a limited number of foreign ions interfere, hence this method is generally applicable after removal of interfering ions by anion exchange. Uranium can also be determined in marine materials. (auth)

2980 DETERMINATION OF TRITIUM IN HUMAN URINE. Kaoru Ueno (Japan Atomic Energy Research Inst., Tokyo), Akira Yabe, Ichiro Tsurumaki, and Chau-ting Chang. J. At. Energ. Soc. Japan, 3: 688-90(Sept. 1961). (In English)

The content of tritium oxide in human urine was estimated by means of liquid scintillation method. Urine sample was purified with 1:2 cation-anion mixed ion exchange column (Diaion, 100 ~ 200 meshes, H and OH-types, ϕ1cm, h10cm), in order to remove both organic and inorganic salts which might bring about the quenching effect in the scintillation. The radioactivity of tritium was measured at room temperature after 1ml portion of the deionized sample was added into 60 ml liquid scintillator. The scintillator was prepared by dissolving 4 g PPO and 15 mg POPOP in the mixed solvent of 230 ml ethanol-770 ml toluene. Althcugh 0.01 μc/ml of tritium can be estimated at room temperature with 10% error, the present method is also applicable to the determination of tritium in radioactive liquid wastes with slight modifications. (auth)

2981 SEMIQUANTITATIVE AUTORADIOGRAPHY WITH THE HELP OF THE RING OVEN. I. GENERALITIES, APPARATUS, AND OPERATION. Herbert Weisz

and Lambert J. Ottendorfer (Technische Hochschule, Vienna). Mikrochim. Acta, No. 2, 191-205(1961). (In German)

Autoradiography as previously described and involving the ring oven technique was developed into a semi-quantitative method for determining radioactive materials. The active materials contained in a test drop are concentrated on filter paper into a sharply defined ring zone. The filter paper with the "active ring" is brought into contact with an x-ray film in an exposure device, which presses them together immovably; the film is gradually raised from the film during the course of step-wise rotary motion. The resulting ring-chronoautoradiogram, after development, shows a ring with increasing blackening. The exposure times of the single steps are increased by the same percentage amounts, the switching times yield a logarithmic series and the ring-chronoautoradiogram is accordingly a ring-shaped stepped grey wedge. About 10 minutes is chosen as the starting time, and $\sqrt[3]{2}$ is used as the factor of the increase in exposure time. The rotary motion occurs in 50 stages. Ring-chronoautoradiograms prepared in the same manner from rings of various numbers of drops of a known standard solution serve for comparison. The assignment of the sample-ring-chronoautoradiogram to the individual standard-ring-chronoautoradiograms is accomplished by rotation until the same blackening is reached. The computing process is given in detail. The construction of the two devices, the exposure apparatus and the switching device, which delivers the impulse required for the rotational movement at the individual times is described. The theoretical bases and the practical possibilities of the method are noted. (auth)

2982 SOURCES OF ERROR IN THE POLAROGRAPHIC DETERMINATION OF MICROGRAMS OF URANIUM (WITH RESPECT TO CONCENTRATION IN SOLID SAMPLES AND WATER). P. Antal (Universität, Vienna). Mikrochim. Acta, No. 2, 235-44(1961). (In German)

On the basis of numerous analytical findings, the sources of error in the polarographic determination of microgram amounts of uranium from solid and liquid samples could be assessed. Further experiments showed that these errors were due to traces of the heavy metals W, Mo (or Pt, V, and Sn) so that it was possible to adjust the analytical methods. (auth)

2983 THE DETECTION OF THORIUM WITH ALIZARIN S AND ITS DETERMINATION ON THE RING OVEN ACCORDING TO WEISZ. L. Hainberger and S. Cuadrado Sanchez (Pontificia Universidade Católica, Rio de Janeiro). Mikrochim. Acta, No. 2, 245-9(1961). (In German)

Aqueous alizarin S solution along with perhydrol and ammonium nitrate was found suitable for the detection of thorium. Since alizarin is not a specific reagent for thorium, an analytical procedure is described, which is suitable for the removal of interfering substances from minerals. The thorium nitrate obtained in this way can be determined quantitatively on the ring oven. (auth)

2984 ELECTRON-SPIN RESONANCE IDENTIFIES RADIOCHEMICAL SPECIES. Edward L. Cochran and Frank J. Adrian (Johns Hopkins Univ., Silver Spring, Md.). Nucleonics, 19: No. 12, 47-50(Dec. 1961).

Three types of electron spin resonance spectra, each of which is important to the study of the effects of high-energy radiation, are distinguished and the method is described. The electron spin resonance spectra distinguished are the single crystal, polycrystalline solids and gases, and fluid media spectra. The method is based on the fact that an atom or molecule with an unpaired electron, when placed in a strong magnetic field, exhibits a hyperfine energy-level structure. (N.W.R.)

2985 COPRECIPITATION OF PLUTONIUM WITH ALIZARIN. Antoni Pasternak (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 6: 113-26(1961). (In English)

An investigation is carried out in order to explain the mechanism of coprecipitation of plutonium with alizarin. A comparison is made of the coprecipitation with alizarin of Pu(III), Pu(IV), Pu(VI), and Pu(IV) in the presence of complexing agents such as alizarin S, TTA, and EDTA. The extraction mechanism advanced by Kuznetsow is found to be a selective adsorption of plutonium on alizarin. (auth)

2986 ISOTOPIC DILUTION ANALYSIS BY ION-EXCHANGE. I. DETERMINATION OF TRACES OF IRON. Jirí Starý and Jaromír Ruzicka (Charles Univ., Prague). Talanta, 8: 775-81(Nov. 1961). (In English)

Isotopic dilution analysis with the use of ion-exchangers serves for the determination of trace amounts of metals. A theoretical evaluation of this method is given, from which the conditions for the determination of a number of metals can be predicted. The selectivity of the method may be further increased by the use of masking and precipitating agents. The proposed method was verified by the determination of iron using EDTA and Dowex 50 cation exchanger. The average precision of mean values for amounts of 10^{-7} g of Fe/5 ml was 1.2%, for amounts of 10^{-8} g of Fe/5 ml, 4.0% and for amounts of 10^{-9} g of Fe/5 ml, 4.1%. Even a large excess of many metals does not interfere in the analysis. The method was applied to the analysis of NaI(Tl) crystals. The procedure which was developed is very simple, and is far more sensitive than colorimetry, activation analysis, or other methods used up to now for determining traces of iron. (auth)

2987 THE DETERMINATION OF TRACES OF GOLD IN SAMPLES OF PLATINUM BY NEUTRON-ACTIVATION ANALYSIS. D. F. C. Morris and R. A. Killick (Brunel Coll. of Tech., London). Talanta, 8: 793-7(Nov. 1961). (In English)

A neutron activation method was developed to determine very small concentrations of gold in samples of platinum. The Harwell nuclear reactor DIDO was used as the source of neutrons. Following irradiation, gold was separated radiochemically from samples and standards. Au^{199} activity was assayed by a discriminated γ-counting method in which Au^{199} activity produced from activation of platinum is not recorded. Results are quoted for the gold contents of some pure platinum samples. (auth)

2988 RADIOKHIMICHESKII ANALIZ PRODUKTOV DELENIYA. SBORNIK STATEI. (Radiochemical Analysis of Fission Products. Collection of Papers). Yu. M. Tolmachev, ed. Moscow-Leningrad, Publishing House of the Academy of Sciences, USSR, 1960. 134p.

Twenty-four papers are included on the determination of fission product yields from U^{235}, U^{238}, and Pu^{239} fission by 14-Mev and fission neutrons. Descriptions are given of the radiochemical methods of separating and purifying Sr^{89}, Sr^{90}, Zr^{95}, Zr^{97}, Mo^{99}, Mo^{101}, Mo^{102}, Ru^{103}, Ru^{106}, Pd^{112}, Ag^{111}, Cd^{115}, Ca^{45}, Co^{65}, As^{74}, Au^{196}, Au^{198}, Tl^{202}, Tl^{204}, Po^{210}, and U^{237}. The quantitative determination of most of the isotopes is based on the method of isotopic dilution. For each isotope the chemical operations are confined to a definite time interval specified by radioactive transformations. The paper is intended for personnel dealing with radiochemical analysis. (R.V.J.)

2989 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR DETERMINING THE METAL OXIDE CON-

TENT OF AN ALKALI LIQUID METAL. William Bateman Hall and Alan Draycott (to United Kingdom Atomic Energy Authority). British Patent 883,632. Dec. 6, 1961.

An apparatus is designed for determining the metal oxide content of an alkali liquid metal in a heat transfer circuit. The apparatus comprises two channels, each containing a barrier having orifices; one barrier is resistant to corrosion by the liquid metal containing the metal oxide, while the other barrier is resistant to corrosion by oxide-free liquid metal but corroded by the metal containing the metal oxide. In operation, the liquid metal being analyzed flows through both barriers, and the pressure difference between the two channels is used as a measure of the metal oxide content. A specific version of the apparatus is described for determining sodium oxide in liquid sodium. (D.L.C.)

General Inorganic and Physical Chemistry

2990 (AERE-R-3853) TEMPERATURE DEPENDENCE OF COMBINED MOLECULAR DIFFUSION AND REVERSIBLE FIRST ORDER CHEMICAL REACTION RATES. P. J. Bourke and W. H. Denton (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Oct. 1961. 16p.

A solution to differential equations is offered for interphase mass transfer processes in which the component transferred takes part in a chemical reaction with a component. The solution of these equations for the case of first-order reversible chemical reaction is given and used to predict the temperature dependence of the transfer rates assuming the usual relations of diffusivity and reactivity with temperature. (J.R.D.)

2991 (IS-342) ENERGY LEVELS OF PLATINUM(II) COMPLEXES ON THE BASIS OF LIGAND FIELD THEORY. Richard Ferdinand Fenske and Don S. Martin (Ames Lab., Ames, Iowa). May 1961. Contract W-7405-eng-82. 249p.

The energy levels of square planar platinum (II) complexes are calculated on the basis of ligand field theory in which a point dipole model was used for the ligands. Configuration interaction, including spin-orbit coupling, was taken into account by the appropriate choice of basic functions for the irreducible representations of the D_{4h} group. The resultant secular equations, derived for both the weak and strong field cases, were solved numerically by means of a high-speed digital computer. Reasonable values for the ligand field, electronic interaction, and spin-orbit coupling parameters were chosen to obtain theoretical transition energies for $(PtCl_4)^{2-}$ and ammonia-substituted chloroplatinates (II) which gave good agreement with experimental values taken from absorption spectra. D_{4h} symmetry was assumed for all the complexes considered in order to simplify the calculations. The proposed energy level assignment for the d-orbitals is: $d_{x^2-y^2} > d_{xy} > d_{z^2} > d_{xz}, d_{yz}$, which differs from an assignment previously reported in the literature in regard to the order of the d_{z^2} orbital and the degenerate d_{xz}, d_{yz} orbitals. Detailed notes on all pertinent derivations of the appropriate wave functions and matrix elements are presented. (auth)

2992 (IS-374) A STUDY OF SEVERAL METALS AS REDUCTANTS FOR YTTRIUM FLUORIDE. J. A. Haefling, F. A. Schmidt, and O. N. Carlson (Ames Lab., Ames, Iowa). Sept. 1961. Contract W-7405-eng-82. 19p.

A study was made in which several metals were used to reduce YF_3 in a metallothermic process. The effectiveness of these reducing agents was compared to that of calcium metal as a reductant for YF_3. Lithium metal and a Ca–Li alloy were found to be efficient reductants when used in an intermediate alloy process. Other metals that were investigated as reducing agents for YF_3 included magnesium, aluminum, sodium, and zinc. (auth)

2993 (NP-10967) REACTION CO_2 GRAPHITE EN PILE SOUS HAUTE TEMPERATURE ET HAUTE PRESSION. ETUDE PRELIMINAIRE: COMPORTEMENT DE QUELQUES METAUX ET ALLIAGES AU CONTACT DU CO_2 A CHAUD HORS PILE. (Reaction of CO_2 and Graphite in Piles at High Temperature and High Pressure. Preliminary Study: Behavior of Some Metals and Alloys in Contact with Hot CO_2 Outside the Pile). P. Magnier (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Jan. 31, 1961. 34p. (DPC/PCA/61-83).

Since CO_2 can behave as an oxidizing agent in contact with certain metals and alloys and thus give rise to quantities of CO sufficient to disturb the study of the CO_2/graphite reaction under radiation, a series of tests were made in order to find a possible catalytic effect of silver or copper on the CO_2/graphite reaction under certain conditions. Copper deposits covered with silver gave satisfaction to 778°C (silver-copper eutectic point). A silica loop permits the determination of the threshold of the CO_2/graphite reaction. Purified graphite, bordering on 650°C was found to be inferior to nuclear graphite. (P.C.H.)

2994 (TID-14281) THERMAL PROPERTIES BASED UPON HEAT CAPACITY AND DECOMPOSITION PRESSURE OF TETRAMETHYLAMMONIUM HYDROGEN DICHLORIDE. THE NATURE OF THE HYDROGEN BOND IN THE $[Cl-H-Cl]^-$ ION. Shu-sing Chang and Edgar F. Westrum, Jr. (Michigan. Univ., Ann Arbor. Dept of Chemistry). [1961]. Contract [AT(11-1)-70]. 33p.

The heat capacity of tetramethylammonium hydrogen dichloride is measured by adiabatic calorimetry from 5 to 350°K, and various thermodynamic properties (entropy, free energy function, etc.) are derived from the measurements. An empirical equation is found to represent the decomposition pressure for the reaction $(CH_3)_4NHCl_2 \rightarrow (CH_3)_4NCl + HCl$ as a function of temperature from 340 to 380°K. The molar entropy increment calculated from the decomposition pressure data is found to agree closely with the increment calculated from the thermodynamic properties. The result is strong support for the hypothesis that the H ion is midway between the Cl ions in the $(Cl-H-Cl)^-$ ion. (T.F.H.)

2995 (CEA-tr-R-1375) COMPOSÉS DU NEPTUNIUM TÉTRAVALENT AVEC L'ACIDE OXALIQUE. (Complexes of Tetravalent Neptunium with Oxalic Acid). P. I. Kondratov (Kondratova) and A. D. Gelman (Helman). Radiokhimiya, 2: No. 3, 315-19(1960). 13p.

The formation of complexes of tetravalent Np with oxalate ions was studied by the method of solubility. The solubility product of neptunium oxalate at 19° was determined to be $8.6 \pm 1.8 \times 10^{-23}$. The instability constants of the oxalate complexes of Np were calculated. (tr-auth)

2996 (CEA-tr-R-1378) LES POTENTIELS D'OXYDO-REDUCTION DU PLUTONIUM DANS DES SOLUTIONS ACIDES DE FORCES IONIQUES DIFFERENTES. (Oxidation Reduction Potentials of Plutonium in Acid Solutions with Different Ionic Forces). O. L. Kabanova and P. N. Paleĭ (Paley). Translated into French from Zhur. Neorg. Khim., 5: 31-4(1960). 15p. (Includes original; 4 p.).

The oxidation-reduction potential of the Pu(III)/Pu(IV) system in $HClO_4$ at 0.5 to 4 M at 25° increases with the con-

centration of the perchloric acid. The oxidation-reduction potential of the system becomes more negative with the increase of chloride in solutions of HCl (1 to 5 M) and of HCl + KCl (1 M HCl + 0.5 to 3.8 M KCl). During the increase of the concentration of the chloride ion 10 times, E_f decreases to 0.058 ± 0.007 v. With the aid of the data obtained, the stability constants of $PuCl^{3+}$ and of $PuCl_2^{2+}$ were calculated as equal to 0.8 and 0.3, respectively (at room temperature). It was found that the exchange current of the Pu(III)/Pu(IV) system with a platinum electrode in 0.8 M HCl at room temperature with 10^{-3} M Pu is higher than 10^{-5} to 10^{-4} amp/cm^2. The absorption spectrum of $PuCl_4$ in 1 M HCl, saturated with potassium chloride, was determined. (tr-auth)

2997 (NP-tr-808) ISOTOPIC MOLECULES OF THE BASIC PRODUCTS OF COMBUSTION AND GASIFICATION OF FUELS. I. G. Petrenko. Translated by H. M. Tomlinson (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Trudy Inst. Goryuchikh Iskopaemykh, Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, 11: 30-8 (1959). 15p.

Proposals are given of equations for the determination of the total number of isotopic molecules of any elementary substance. Calculations were made of the concentrations of isotopic molecules of water, carbon monoxide, carbon dioxide, methane, and sulfur dioxide, under conditions of equilibrium statistical distribution of isotopes without considering the isotopic effect. (B.O.G.)

2998 OUT-OF-PLANE HYDROGEN VIBRATIONS OF ORTHO-, META-, AND PARA-DEUTERATED MONOSUBSTITUTED BENZENES. Yuzo Kakiuti and Jiro Ogura (St. Paul's Univ., Tokyo). Bull. Chem. Soc. Japan, 34: 899-905(July 1961).

Frequencies and absorption intensities of the out-of-plane hydrogen vibration bands were calculated for some deuterium homologs of benzene derivatives. The normal coordinate treatment was carried out according to the method using G and F matrices. The values of the elements of the G matrix are nearly the same as those presented in previous papers, and those of the F matrix are exactly the same, because the same force constants obtained by the analysis of out-of-plane vibrations of benzene and its deuterium homologs were applied in this case. The spectra of ortho-, meta-, and para-deuterated toluene and of para-deuterated derivatives of bromobenzene, styrene, and poly styrene are used as comparisons. The data are tabulated. (P.C.H.)

2999 THE PEROXIDE COMPOUNDS OF ZIRCONIUM AS THE PRODUCTS OF INTERACTION BETWEEN HYDROXIDE AND HYDROGEN PEROXIDE. S. Z. Makarov and L. V. Ladeinova (Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Otdel Khim. Nauk, No. 7, 1169-75(July 1961). (In Russian)

Three peroxide phases $ZrO_3 \cdot 2\ H_2O$, $ZrO_3 \cdot H_2O$, and ZrO_3 were observed in $Zr(OH)_4$ reaction with H_2O_2 at 0 to 20°C. Dehydration experiments and differential thermal analysis curves show that $ZrO_3 \cdot 2\ H_2O$ and $ZrO_3 \cdot H_2O$ are hydroperoxide compounds [$Zr(OOH)(OH)_3$ and $ZrO(OOH)(OH)$] while ZrO_3 is of the O = Zr type. (R.V.J.)

3000 THE PEROXIDE COMPOUNDS OF CERIUM. S. Z. Makarov and L. V. Ladeinova (Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, No. 7, 1176-82 (July 1961). (In Russian)

Studies of $Ce(OH)_4$ reactions with H_2O_2 (96.32%) at 0 to −20°C revealed the phases $CeO_3 \cdot 2\ H_2O$, CeO_3, and CeO_4. Differential heat curves show the presence of an exothermal effect related to the dissociation of absorbed hydrogen peroxide and an endothermal effect caused by dehydration. Dehydration of $CeO_3 \cdot 2\ H_2O$ results in $CeO_3 \cdot H_2O$. (R.V.J.)

3001 THE BEHAVIOR OF FISSION PRODUCT RARE GASES IN THE CHANGE OF SOLID PHASE. OXIDATION AND REDUCTION OF URANIUM OXIDES. Sumio Ichiba (Japan Atomic Energy Research Inst., Tokyo). J. At. Energ. Soc. Japan, 3: 705-10(Sept. 1961). (In Japanese)

The oxidation and reduction behaviors of uranium oxides were studied by the fission gas emanation method. Three peaks were found in the heating curve of oxidation of UO_2. The temperatures and ranges where the peaks appear changed with the particle size. An x-ray diffraction method, thermal balance, and O/U measurement were used to identify the existing phases. The oxidation of UO_2 occurs at the first peak. A slightly oxygen-rich phase of U_3O_8 was observed in the second peak, followed by the third peak where a slightly uranium-rich phase of U_3O_8 was observed. The reduction of U_3O_8 to UO_2 with hydrogen occurs at about 600°C. The mechanism of xenon release from the oxide crystals when the oxidation or reduction occurs was also studied. (auth)

3002 SPECTRUM AND MAGNETIC PROPERTIES OF HEXAGONAL $DyCl_3$. H. M. Crosswhite and G. H. Dieke (Johns Hopkins Univ., Baltimore). J. Chem. Phys., 35: 1535-48(Nov. 1961).

The absorption and fluorescence spectra of anhydrous $DyCl_3$ were investigated and the levels up to 37,000 cm^{-1} above the ground state established. Conclusive evidence is presented that the levels below 15,000 cm^{-1} belong to the ^6H and ^6F multiplets. The Zeeman effects show considerable nonlinear interactions which follow quantitatively the existing theory. The 12 low levels and their electric and magnetic field splittings are reasonably well represented by the simplified theory with L-S coupling, with the approximate crystal parameters $B_2^0 = A_2^0\langle r^2\rangle = 89.8$ cm^{-1}, $B_4^0 = -40.0$ cm^{-1}, $B_6^0 = -23.3$ cm^{-1}, $B_6^6 = 253$ cm^{-1}. (auth)

3003 LOW-TEMPERATURE HEAT CAPACITIES AND THERMODYNAMIC FUNCTIONS OF SOME PLATINUM AND PALLADIUM GROUP CHALCOGENIDES. I. MONOCHALCOGENIDES. PtS, PtTe, AND PdTe. Fredrik Groenvold (Univ. of Oslo), Torkild Thurmann-Moe, Edgar F. Westrum, Jr., and Elfreda Chang. J. Chem. Phys., 35: 1665-9(Nov. 1961).

Heat capacities of platinum monosulfide, platinum monotelluride, and palladium monotelluride were measured in the range 5−350°K. They show the normal sigmoidal temperature dependence with no evidence of transitions or other anomalies. The derived heat-capacity equations were integrated. Values of heat capacities, entropy, and enthalpy increments, and of the free-energy function are tabulated for selected temperatures. At 298.15°K, the third-law entropies are 13.16 cal gfw^{-1} °K^{-1} for PtS, 19.41 cal gfw^{-1} °K^{-1} for PtTe, and 21.42 cal gfw^{-1} °K^{-1} for PdTe. The new data on PtS were correlated with existing decomposition-pressure data to evaluate ΔHf, ΔFf, and ΔSf 298.15°K. Entropies for other platinum-metal monochalcogenides were estimated. (auth)

3004 LOW-TEMPERATURE HEAT CAPACITIES AND THERMODYNAMIC FUNCTIONS OF SOME PALLADIUM AND PLATINUM GROUP CHALCOGENIDES. II. DICHALCOGENIDES. PtS_2, $PtTe_2$, AND $PdTe_2$. Edgar F. Westrum, Jr. (Univ. of Michigan, Ann Arbor), H. Gary Carlson, Fredrik Groenvold, and Arne Kjekshus. J. Chem. Phys., 35: 1670-6(Nov. 1961).

Heat capacities of platinum disulfide, platinum ditelluride, and palladium ditelluride were measured in the range 5° to 350°K. They show the normal sigmoidal temperature dependence with no evidence of transitions or other anomalies. The derived heat capacity equations were integrated. Values of C_p, $S^0-S^0_0$, $H^0-H^0_0$, and $-(F^0-H^0_0)/T$ are tabulated for selected temperatures. At 298.15°K the entropies are 17.85 cal gfw^{-1} $°K^{-1}$ for PtS_2, 28.92 cal gfw^{-1} $°K^{-1}$ for $PtTe_2$, and 30.25 cal gfw^{-1} $°K^{-1}$ for $PdTe_2$. Thermodynamic values were estimated for other dichalcogenides and related chalcogenides of the platinum group metals. (auth)

3005 PARAMAGNETIC RESONANCE OF SOME SILVER(II) COMPOUNDS. J. A. McMillan and B. Smaller (Argonne National Lab., Ill.). J. Chem. Phys., 35: 1698-1701(Nov. 1961).

The electron paramagnetic resonance of acidic solutions of silver(II) and several silver(II) solid complex compounds was investigated. In all cases a strong g anisotropy permitted the evaluation of the principal g values. In two cases, the hyperfine splitting could be measured without ambiguity. Parallel measurements of the optical and ultraviolet absorption in the case of silver(II) solutions indicated that the hole is not localized on the paramagnetic ion. (auth)

3006 NEUTRON DIFFRACTION STUDY OF SOLID DEUTEROAMMONIA. John W. Reed (Ohio State Univ., Columbus and Hughes Research Labs., Malibu, Calif.) and P. M. Harris. J. Chem. Phys., 35: 1730-7(Nov. 1961).

The crystal structure of the stable cubic modification of solid deuteroammonia was determined by neutron diffraction. The space group is $P2_13-T^4$, and at −196°C the positions of the atoms are 4N at u = 0.2127 ± 0.0021 and 12D at x = 0.3740 ± 0.0019, y = 0.2632 ± 0.0037, and z = 0.1094 ± 0.0016. Each nitrogen atom is hydrogen bonded to the six nearest neighbor nitrogen atoms. There is one deuterium atom per site, in contrast to the half-hydrogen structure of ice. The N−D bond length of 1.005 ± 0.023 A is indistinguishable from that of the free molecule, while the D−N−D bond angle of 110.4° ± 2.0° is appreciably larger than the free molecule value. (auth)

3007 STUDIES OF TRANSIENT SPECIES FORMED DURING CATALYTIC REACTIONS OF CO_2 + D_2 AND 1-BUTENE. Charles E. Melton (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 35: 1751-7(Nov. 1961).

Transient species in a catalyzed reaction were observed in the gas phase by placing the catalyst in a specially designed mass spectrometer ion source. The reaction, $D_2 + CO_2 \xrightarrow{Pt} D_2O + CO$, was studied over a pressure range 0.1−1 mm Hg and a temperature range 50−1100°C to demonstrate the applicability of the techniques. A free radical, of molecular formula CDO, was shown to be formed by and desorbed from the Pt catalyst during the reaction. In addition, $DCOO^-$ ions were observed suggesting the presence of an intermediate DCOOD on the catalyst. The production of the products CO and D_2O was not a monotonic function of catalyst temperature, but instead showed a maximum in the temperature range 400−500°C. The rate increased approximately as the first power of P_{CO_2} and was nearly independent of the partial pressure of D_2. The catalytic decomposition of butene-1 was studied in the same way. Free radicals produced by the catalytic decomposition of this compound are compared to those known to occur from thermal decomposition at the same temperature. In the catalytic decomposition, the radicals C_4H_7 and C_3H_5 were found to be most abundant; in contrast, CH_3 and C_3H_5 are most abundant in the thermal decomposition. (auth)

3008 PARAMAGNETIC RELAXATION IN METAL-AMMONIA SOLUTIONS. D. E. O'Reilly (Argonne National Lab., Ill.). J. Chem. Phys., 35: 1856-62(Nov. 1961).

Relaxation processes for electrons in alkali metal−ammonia solutions are calculated to proceed via hyperfine interaction with nitrogen-14 nuclei in dilute solutions (< 0.15M) and via spin-orbit interactions in concentrated solutions. Dipolar and exchange interactions are estimated to make only a small contribution to the observed relaxation times. Comparison of the mean square width due to the hyperfine interaction as obtained from relaxation time data and the observed N^{14} Knight shift allows a construction of an effective wave function for the electron in dilute solutions. In more concentrated solutions (0.60M) relaxation results from fluctuations in the electric potential at an unpaired electron with a correlation time of the order of 10^{-14} sec. Effects due to the substitution of D for H and Na for K are examined. (auth)

3009 PHASE EQUILIBRIA AND TIN-ACTIVATED LUMINESCENCE IN STRONTIUM ORTHOPHOSPHATE SYSTEMS. J. F. Sarver, M. V. Hoffman, and F. A. Hummel (Pennsylvania State Univ., University Park). J. Electrochem. Soc., 108: 1103-10(Dec. 1961).

Strontium orthophosphate undergoes a rapid, reversible transition at 1305°C. The high-temperature β form of pure $Sr_3(PO_4)_2$ cannot be quenched to room temperature, even with extremely rapid cooling. Determination of phase relationships on the orthophosphate joins between $Sr_3(PO_4)_2$ and each of the three orthophosphates, $Mg_3(PO_4)_2$, $Ca_3(PO_4)_2$, and $Zn_3(PO_4)_2$ showed that they form β-$Sr_3(PO_4)_2$ solid solutions which could be cooled to room temperature to form the basis for the so-called modified strontium orthophosphate phosphors. The ranges of composition and temperature over which the β-$Sr_3(PO_4)_2$ solid solutions exist were determined for each system, and the existence of two ternary compounds, $SrMg_2(PO_4)_2$ and $SrZn_2(PO_4)_2$, was confirmed. The latter compound has a transition at 1035°C, but the high-temperature form can be maintained at room temperature only by extremely rapid quenching. Equilibrium diagrams of each of the systems are presented to show all stability relationships. The behavior of tin-activated β-$Sr_3(PO_4)_2$ solid solution phosphors in each of the three systems was explored under 2537 Å excitation, and the relation of phosphor composition to quantum efficiency, brightness, and temperature stability in the lamp-making range was determined. The tin-activated luminescence of the two ternary compositions was investigated using 2537 Å, 3650 Å, and cathode ray excitation. (auth)

3010 THE INFLUENCE OF THE VALUE OF THE TRANSFERENCE NUMBER OF THE UNIVALENT ION ON THE EQUIVALENT CONDUCTANCE OF BIUNIVALENT ELECTROLYTES. Neal Goldenberg and Edward S. Amis (Univ. of Arkansas, Fayetteville). J. Electrochem. Soc., 108: 1167-8(Dec. 1961).

In order to justify that it is necessary to know the transference number, $t^0_{Cl^-}$, at infinite dilution of the chloride ion in the various solvents in order to evaluate the equivalent conductance, Λ_0, of the chlorides at infinite dilution and the dissociation constant, K, of the salt, calculations employing an IBM 650 computer were carried out, based on the Shedlovsky theory, to test the sensitivity of values of Λ_0 and K to the value of $t^0_{Cl^-}$ employed. The tests on Λ_0 were carried out using conductance data on strontium, barium, magnesium, calcium, and uranyl chloride, and tests on K values were made on conductance data for uranyl chloride. The salts, other than uranyl chloride, were studied in water. Uranyl chloride was studied in ethanol and

ethanol–water systems. Results show that the values of Λ_0 are rather insensitive to small changes in $t^0_{Cl^-}$. The values of $t^0_{Cl^-}$ corresponding to Shedlovsky's Λ_0 values are about 0.30, 0.45, 0.58, and 0.48, respectively, for strontium, barium, magnesium, and calcium chlorides. These values ($t^0_{Cl^-}$) are not so consistent, and the value for strontium is markedly small as compared with Shedlovsky's value of 0.562. (N.W.R.)

3011 COMPARATIVE RATES OF THE ELECTROLYTIC EVOLUTION OF HYDROGEN AND DEUTERIUM ON IRON, TUNGSTEN AND PLATINUM. J. O'M. Bockris and D. F. A. Koch (Univ. of Pennsylvania, Philadelphia). J. Phys. Chem., 65: 1941-8(Nov. 1961).

Methods previously described for the determination of the mechanism of hydrogen evolution and dissolution do not allow the slow electrochemical desorption step to be distinguished from that of proton transfer. The fact that theory indicates a ratio of $(i_0)_{H_3O^+}/(i_0)_{D_3O^+}$ characteristic of mechanism is used in this study. The exchange current density for hydrogen evolution was determined in 0.5 M HCl dissolved in H_2O and in 0.5 M DCl dissolved in D_2O under conditions of high purity. The ratio of the exchange current densities is 4 for Fe, 8 for W, and 3 for Pt. Tafel slopes are the same for both isotopes. The concentrations of the relevant entities present in D-containing solutions are calculated. Equations are derived from which $(i_0)_{D_3O^+}$ can be obtained from the apparent exchange current density in D solution containing a few molecular per cent of water. Relations are derived for the dependence of the separation factor, S, on the c_D/c_H ratio in solution. Limiting values of S exist as c_D/c_H tends to zero and to infinity, in which S is simply related to $(i_0)_{H_3O^+}/(i_0)_{D_3O^+}$. Discussion of available values of S, and the exchange current density ratio, gives information on mechanisms following the rate-determining reaction. The theoretical values of exchange current density ratios arising from assumption of a given mechanism depend on the differences in the heat of adsorption of H and D on the metal. Two methods of estimating this are given. The evidence favors a choice of 0.2 kcal $mole^{-1}$ for all metals. The results are consistent with rate-controlling proton transfer to iron, electrochemical desorption from tungsten and atomic combination of platinum. (auth)

3012 SOLUBILITY AND COMPLEX ION FORMATION OF SILVER CHLORIDE IN MOLTEN NITRATES. R. A. Osteryoung, C. Kaplan, and D. L. Hill (Rensselaer Polytechnic Inst., Troy, N. Y.). J. Phys. Chem., 65: 1951-4 (Nov. 1961).

The solubility of silver chloride in the molten equimolar potassium nitrate–sodium nitrate solvent was investigated at 280° in the presence of a varying excess of chloride ion. The results are interpreted in terms of the formation of the species AgCl and $AgCl_2^-$, and formation constants for these species are determined. (auth)

3013 AN ULTRASENSITIVE THERMISTOR MICROCALORIMETER AND HEATS OF SOLUTION OF NEPTUNIUM, URANIUM AND URANIUM TETRACHLORIDE. G. R. Argue, E. E. Mercer, and J. W. Cobble (Purdue Univ., Lafayette, Ind.). J. Phys. Chem., 65: 2041-8(Nov. 1961).

A sensitive solution microcalorimeter using a thermistor-amplifier bridge and automatic recording was constructed and evaluated. The sensitivity of the instrument is 1×10^{-5}°; with magnesium, heats of solution in 1 M HCl were measured to ±0.2% with samples as small as 19.51 μg. The device was designed primarily for use in determining the thermodynamic functions of actinide elements and their compounds. The heats of formation of U(IV) in 1 M HCl, U^{4+}(aq.) and UCl_4 (c) were redetermined and new values are reported for Np(IV), Np(III) in 1 M HCl, and Np^{4+}(aq.), Np^{3+}(aq.). (auth)

3014 POLYMORPHISM OF THE RARE EARTH SESQUIOXIDES. I. Warshaw and Rustum Roy (Pennsylvania State Univ., University Park). J. Phys. Chem., 65: 2048-51(Nov. 1961).

Under equilibrium conditions the polymorphic forms of the rare earth sesquioxides transform reversibly from one form to the other. The sesquioxides of the largest ions, La, Ce, and Pr, exhibit the A-type structure, Nd_2O_3 exists both as A- and C-type, while Sm_2O_3, Eu_2O_3, Gd_2O_3, Tb_2O_3, and Dy_2O_3 exist both as B- and C-type oxides. The remaining rare earth sesquioxides occur only in the C-type structure. The C to B transition temperature increases linearly with decreasing ionic radius of the rare earth cation. (auth)

3015 CALCIUM–CALCIUM HYDRIDE PHASE SYSTEM. D. T. Peterson and V. G. Fattore (Ames Lab., Ames, Iowa and Centro Studi e Ricerche Bollate, Milan). J. Phys. Chem., 65: 2062-4(Nov. 1961).

The CaH_2 phase diagram was studied by thermal analysis and chemical analysis of equilibrated phases. The maximum solubility of CaH_2 in calcium metal is 24 mole % at the peritectic temperature of 890°. Calcium metal undergoes an allotropic transition at 448 ± 2° and melts at 839 ± 2°. An intermediate phase, stable between 320 to 600°, is produced by hydrogen. Calcium hydride shows an allotropic transformation at 780°. (auth)

3016 THE LOW TEMPERATURE MAGNETIC PROPERTIES AND MAGNETIC ENERGY LEVELS OF SOME RARE EARTH CHELATES OF ACETYLACETONE AND ETHYLENEDIAMINETETRAACETIC ACID. J. J. Fritz, P. E. Field, and Ingmar Grenthe (Pennsylvania State Univ., University Park). J. Phys. Chem., 65: 2070-4(Nov. 1961).

The magnetic susceptibilities of powdered specimens of nine acetylacetonates and three ethylenediaminetetraacetate complexes of the rare earths were measured from 1.3 to 20°K. Measurements were made with an a-c bridge using frequencies from 100 to 2000 cycles. In the case of dysprosium acetylacetonate (only) relaxation effects were observed, corresponding to a spin-lattice relaxation time of about a millisecond. The temperature dependence of the susceptibilities was analyzed for crystalline fields of cubic and of trigonal symmetry. The results are better represented by the cubic field, but show distinct deviations corresponding to lower symmetry. (auth)

3017 RATE OF ELIMINATION OF WATER MOLECULES FROM THE FIRST COORDINATION SPHERE OF PARAMAGNETIC CATIONS AS DETECTED BY NUCLEAR MAGNETIC RESONANCE MEASUREMENTS OF O^{17}. Robert E. Connick and E. Diane Stover (Univ. of California, Berkeley). J. Phys. Chem., 65: 2075-7(Nov. 1961).

Earlier nuclear magnetic resonance measurements on the rates of exchange of water molecules between bulk water and the first coördination sphere of cations were amplified and refined using water enriched in O^{17}. Limits for the rates of these processes were calculated from the transverse relaxation time. A sideband technique was used in making the measurements. The following lower limits for the first-order rate constants for the exchange of a particular water molecule in the first coördination sphere were found: Mn^{2+}, 2.2×10^7 sec^{-1}; Cu^{2+}, 3.3×10^6 sec^{-1}; Co^{2+}, 3.1×10^5 sec^{-1}; Ni^{2+}, 3.2×10^4 sec^{-1}; and Fe^{3+}, 2.4×10^4 sec^{-1}. (auth)

3018 THE RATE OF DISSOCIATION OF PERCHLORATE ION IN FUSED SODIUM HYDROXIDE. Ralph P.

Seward and Harry W. Otto (Pennsylvania State Univ., University Park). J. Phys. Chem., 65: 2078-81(Nov. 1961).

Sodium perchlorate in fused sodium hydroxide at temperatures from 360 to 420° is found to decompose to chloride in two consecutive first-order reactions. Rate constants for conversion of perchlorate to chlorate and from chlorate to chloride were evaluated, the first step being the faster. Respective activation energies of 47.3 and 53.2 kcal mole^{-1} were calculated. Decomposition rates are much greater in fused sodium hydroxide than in fused sodium nitrate. It is suggested that the decomposition is promoted by hydroxyl ion through the formation of a peroxide intermediate. (auth)

3019 A SPECTROPHOTOMETRIC STUDY OF THE REACTION BETWEEN FERRIC ION AND HYDRAZOIC ACID. R. M. Wallace and E. K. Dukes (E. I. du Pont de Nemours & Co., Aiken, S. C.). J. Phys. Chem., 65: 2094-7(Nov. 1961).

A spectrophotometric study of the reaction between Fe^{3+} and HN_3 demonstrated that the complex FeN_3^{2+} was formed. The molar extinction coefficient of FeN_3^{2+} was 3.68×10^3 at the absorption peak of 460 mμ. Equilibrium constants for the reaction $Fe^{3+} + HN_3 \rightleftharpoons FeN_3^{2+} + H^+$ were measured under a variety of conditions. The equilibrium constant at 25°, extrapolated to infinite dilution, was 1.71; the ΔH of the reaction was 2010 ± 100 cal. Anomalous results for the equilibrium constant at very low acid concentrations were attributed to the hydrolysis of Fe^{3+} to $FeOH^{2+}$. (auth)

3020 A SIMPLE MICRODIFFUSION TECHNIQUE FOR THE RADIOIODINATION OF PROTEINS. R. N. Banerjee and R. P. Ekins (Middlesex Hospital, London). Nature, 192: 746-7(Nov. 25, 1961).

Conway's microdiffusion technique is described for the incorporation of I^{131} in proteins and was used successfully on insulin, β- and γ globulins, albumin, and tyrosine. Specific activities of the order of 100 mc/mg insulin can readily be achieved with 3 to 5 mc I^{131} and less than 5 μg of the protein, and the iodinated protein is radiochemically pure. Although the over-all recovery of radioactivity is only ~25%, the method has the advantages of mild oxidative environment and minimal radiation damage to the protein. (D.L.C.)

3021 DETERMINATION AND APPLICATION OF THE DIFFUSION COEFFICIENT FOR HYDROGEN IN URANIUM AT 800°C. C. J. Oblinger (National Lead Co. of Ohio, Cincinnati) and H. A. Dube. Nuclear Sci. and Eng., 11: 263-6 (Nov. 1961).

A diffusion coefficient for hydrogen in ingot uranium was determined at 800°C on 1-in. long slug blanks. A value of 14.2×10^{-5} cm^2/sec was obtained from 15 determinations. The precision of the average value at the 95% confidence level was ±3.6%. Three methods of cleaning (preparatory to analysis) were employed, no bias being detected among them. An equation was used to calculate the total gas dissolved in a sample by measuring the gas evolved after a short time and using the diffusion coefficient. In a comparison of the total evolved gas (3-hr extraction) with the calculated total gas (½-hr extraction), an error of < ±2% was obtained from 15 samples. (auth)

3022 DIPOLE MOMENTS OF COMPLEXES OF URANYL NITRATE WITH TRIBUTYLPHOSPHATE. Jerzy Michalczyk and Jozef Hurwic (Technical Univ., Warsaw). Nukleonika, 6: 503-9(1961). (In Polish)

A method of preparation of dehydrated concentrated solution of uranyl nitrate in tributylphosphate (TBP) was formulated. The analysis indicates that uranyl nitrate forms with TBP two complexes: $UO_2(NO_3)_2 \cdot$ TBP and $UO_2(NO_3)_2 \cdot 2$TBP. The liquid tricomponent system: benzene — uranyl nitrate — TBP was investigated in concentrations. The dielectric constant measured by heterodyne beat method, refraction index by refractometric method and viscosity by pycnometric method were determined in the temperature of 20°C. The dipole moments of complexes: $UO_2(NO_3)_2 \cdot$ TBP and $UO_2(NO_3)_2 \cdot 2$TBP were determined by dual extrapolation. The results are: μ_1 = 3.04 D and μ_2 = 3.47 D. (auth)

3023 NOTE ON THE KINETIC ISOTOPE EFFECTS IN DECARBOXYLATION OF PICOLINIC ACID IN FUSED STATE AND IN SOLUTIONS. Ignacy Złotowski and Mieczyław Zieliński (Univ. of Warsaw). Nukleonika, 6: 511-15(1961). (In English)

Kinetic isotope effects of C^{14} occurring in decarboxylation of picolinic acid in the fused state as well as in acid and alkaline solutions were investigated at 155 to 200°C. A preliminary theoretical analysis of the results is given. (auth)

3024 MATHEMATICS OF DIFFUSION-CONTROLLED PRECIPITATION IN THE PRESENCE OF HOMOGENEOUSLY DISTRIBUTED SOURCES AND SINKS. L. A. Girifalco and D. R. Behrendt (Lewis Research Center, Cleveland). Phys. Rev., 124: 420-7(Oct. 15, 1961).

The growth-rate equations were derived for diffusion-controlled precipitation while the diffusing species is continually being created and destroyed throughout the material. Three mechanisms were treated: (1) bulk diffusion from a large spherical region to a small, concentric spherical particle; (2) diffusion in a spherical region to the wall of the sphere and subsequent instantaneous diffusion to a precipitate particle on the sphere's surface; and (3) two-dimensional diffusion in a circular region to a spherical particle located at the center of the circle. Ham's method, in which the concentration is expanded in eigenfunctions of an appropriate eigenvalue problem, was extended to take into account the presence of sinks and sources. The resulting equations were solved with the aid of a digital computer. The results show that, in the short-time approximation, the radius is proportional to the time for case (1), the radius is proportional to the cube root of the time for case (2), and the radius shows a rapid rise at very short times and then a slower, almost linear increase with time for case (3). For long times, the shape of the radius-time curves is more complex. (auth)

3025 ENERGY TRANSFER IN POLYATOMIC MOLECULES. I. CATALYSIS OF ENERGY TRANSFER WITH ISOTOPIC MOLECULES. G. H. Hudson, J. C. McCoubrey, and A. R. Ubbelohde (Imperial Coll. of Science and Tech., London). Proc. Roy. Soc. (London), A264: 289-98(Nov. 21, 1961).

Dispersion of sound was compared for ethylene and tetradeutero-ethylene. Relaxation times of 0.26 and 0.14 μs for these molecules follow the general trend with molecular frequencies predicted by theory. A quantitative account of the observed ratio 1:2 of relaxation times can best be given by introducing the notion of complex collisions and by abandoning the concept that the rate of activation of the lowest vibrational mode fully controls the rate of activation of higher modes. Small amounts of C_2D_4 or $C_2D_2H_2$ act as energy transfer catalysts for ethylene. Both H_2O and D_2O likewise act as catalysts, approximately to the same extent. Theoretical interpretations of these findings are discussed. (auth)

3026 ENERGY TRANSFER IN POLYATOMIC MOLECULES. II. RELATIVE CATALYTIC EFFICIENCY FOR ENERGY TRANSFER TO DIFFERENT VIBRATIONS

TO THE SAME MOLECULE. J. C. McCoubrey, R. C. Milward, and A. R. Ubbelohde (Imperial Coll. of Science and Tech., London). Proc. Roy. Soc. (London), A264: 299-308(Nov. 21, 1961).

Vibrations of sulfur dioxide show two separate relaxation times. Values of $\tau_1 = 6.0 \times 10^{-8}$ s for the vibrations of 519 cm^{-1} and $\tau_2 = 1.2 \times 10^{-6}$ s for the vibrations of 1151 and 1361 cm^{-1} were derived from new ultrasonic measurements, in fair agreement with earlier work. Molecules studied as possible vibration-translation catalysts included ethane, ethylene, water, and n-hexane. No enhanced efficiency of energy transfer was observed with ethylene. Ethane and water molecules were found to be only moderately efficient catalysts; proportionally, they exert a greater effect for processes associated with τ_1. Deuterium oxide is found to be somewhat more efficient than water. n-Hexane is highly efficient for both the τ_1 and τ_2 relaxation processes of sulfur dioxide. These observations are discussed in relation to various mechanisms for the catalysis of energy transfer. (auth)

3027 RELATIVE INTENSITIES FOR THE ARC SPECTRA OF SEVENTY ELEMENTS. William F. Meggers, Charles H. Corliss, and Bourdon F. Scribner (National Bureau of Standards, Washington, D. C.). Spectrochim. Acta, 17: 1137-72(Nov. 1961).

The relative intensities, or radiant powers, of 39000 spectral lines with wavelengths between 2000 and 9000 Å were determined on a uniform energy scale for seventy chemical elements. This was done by mixing 0.1 at % of each element in powdered copper, pressing the powder mixture to form solid electrodes which were burned in a 10-A, 220-V d-c arc, and photographing the spectra with a stigmatic concave grating while a step-sector was rotating in front of the slit. The sectored spectrograms facilitated the estimation of intensities of all element lines relative to copper lines which were then calibrated on an energy scale provided by standardized lamps, and all estimated line intensities were finally adjusted to fit this calibration. Comparisons with other intensity measurements in individual spectra indicate that the spectral-line intensities may have errors of 20%, but they first of all provide uniform quantitative values for the seventy chemical elements commonly determined by spectrochemists. About 1100 of the lines are presented as a list of the strong lines of each element. Energy levels and term combinations are given for each classified line. (auth)

3028 STUDIES ON THE HYDROLYSIS OF METAL IONS. A Review of the Hydrolysis of Bi^{3+}, Pb^{2+}, Ca^{2+}, Sr^{2+}, and Ba^{2+}. Åke Olin (Royal Inst. of Tech., Stockholm). Svensk Kem. Tidskr., 73: 482-500(1961). (In English)

The hydrolysis of Bi^{3+}, Pb^{2+}, Ca^{2+}, Sr^{2+}, and Ba^{2+} is reviewed. Various instrumental methods used for identifying the species of polynuclear complexes formed are also discussed. It is concluded that the emf method is in general superior to other physico-chemical methods for such studies. (auth)

3029 INVESTIGATION OF BORATE SOLUTIONS BY THE METHOD OF ION-EXCHANGE. E. A. Materova, M. G. Valyashko, E. V. Parshikova, and S. B. Evnina. Vestnik Leningrad. Univ., 16: No. 10, Ser. Fiz. i Khim. No. 2, 125-32(1961). (In Russian)

Boron sorption by anion exchangers is investigated and shown to be a function of pH and concentration. The existence of maximum curves (the absorbed quantity–pH) points to some variation in boron anion form. The region of maximum sorption seems to be related to $B_4O_7^{2-}$ anion sorption. (auth)

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Refer also to abstracts 3308, 3318, 3319, 3320, 3321, 3322, 3323, 3324, 3327, 3328, 3329, 3343, 3344, 3345, 3347, 3348, and 3350

3030 (AFOSR-1541) LOW-TEMPERATURE KINETIC BEHAVIOR OF HYDROGEN ATOMS IN GAMMA-IRRADIATED ICE. John M. Flournoy, Lillian H. Baum, and Seymour Siegel (Aerojet-General Corp., Azusa, Calif.). Nov. 1961. Contract AF18(603)-110. 21p. (TN-42)

The rate of disappearance of trapped H atoms in gamma-irradiated ice was studied at temperatures up to 60°K. H atoms produced by gamma-irradiation of ice at 4.2°K appear to be trapped in a variety of different sites, with activation energies for de-trapping ranging from less than 1.0 to more than 2.0 kcal/mole. The results are discussed in terms of various models; the preferred model involves an initially non-isotropic spatial distribution. (auth)

3031 (NARF-61-37T) SYNRADSIS. THE SYNTHESIS OF CHEMICAL COMPOUNDS THROUGH THE USE OF NUCLEAR RADIATION. G. K. Able, Jr. (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Nov. 17, 1961. Contract AF33(657)-7201. 72p. (MR-N-288)

"Synradsis" is a portmanteau word for the phrase "synthesis of chemical compounds through the use of nuclear radiation, alone or in conjunction with heat, pressure, catalysts, or other conventional techniques." A set of guiding principles for planning and executing a synradsis, the advantages of synradsis over conventional techniques, the kinds of reactions that appear favorable to synradsis, and some specific synradses that look promising are discussed. A two-part bibliography in which examples of synradses taken from the literature are described, and abstracts of literature articles are listed in accordance with the type of synradsis reaction (addition, alkylation, etc.) is included. (auth)

3032 (NP-11081) FUNDAMENTAL STUDIES OF RADIATION SOURCE DOSIMETRY AND THE EFFECTS OF IONIZING RADIATION ON SUGARS. Report No. 9 (Final), April 1, 1957–March 31, 1961. J. S. Andrews (General Mills, Inc. Central Research Labs., Minneapolis). 4p. Contract QMR&E (Natick) No. 78.

Results are reported from studies on the effects of γ radiation on glucose. Formic and gluconic acids were identified as irradiation products of glucose solutions. Changes in pH and ultraviolet absorption maxima were also observed after irradiation. A small thimble-type ionization chamber is described. Data are included on the effect of moisture on the radiation response of a blue cellophane-dye dosimeter. (C.H.)

3033 (TID-13917) RADIATION STABILITY OF ORGANIC LIQUIDS. Semi-Annual Report No. 2 for period February 1 to July 31, 1961. A. H. Samuel and R. S. Farrand (Stanford Research Inst., Menlo Park, Calif.). July 31, 1961. Contract AT(04-3)-115. 24p. For Oak Ridge National Lab., Tenn.

The system TBP–Amsco–H_2O–HNO_3 was investigated at initial HNO_3 concentrations from 1 to 5 N at dose levels of 45 and 135 whr/l. G values were determined for the disappearance of HNO_3 ($G(-HNO_3)$) and for the formation of DBP and MBP. The results indicate that $G(-HNO_3)$ and G(DBP) increase with HNO_3 concentration and decrease with dose, that DBP approaches a steady-state concentra-

tion, and that MBP is not the main product of DBP radiolysis. There is some evidence for formation of nitroso compounds, and a tentative radiolysis mechanism is suggested. Analytical procedures for U were adapted to the TBP–Amsco–$UO_2(NO_3)_2$–HNO_3–H_2O system, and preliminary experiments were run to test the change of the U partition coefficient with dose. (D.L.C.)

3034 (UCRL-9660) REMOTE PLASTIC BAG PASS-OUT UNIT FOR HIGH-LEVEL RADIOCHEMICAL OPERATIONS. E. S. Fleischer, T. C. Parsons, and P. W. Howe (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1961. Contract W-7405-eng-48. 12p.

A system is designed for making remote sealed-bag passouts from a multicurie-level chemistry processing enclosure. The polyethylene bags are changed remotely without exposing contaminated surfaces while always maintaining a low leak rate seal. The system employs an interchange box (passout box) attached to the chemistry enclosure. Integrated with the box is a hydraulically operated jack that raises and lowers the bags, and a welder-cutter for sealing them. A single master-slave manipulator teamed with the above units handles all operations. (auth)

3035 (AEC-tr-4863) PHOTOCHEMICAL OXIDATION OF FERROUS IONS IN AQUEOUS SOLUTION. STUDY OF THE INVERSE REDUCTION REACTION BY ATOMIC HYDROGEN. Marc Lefort and Pierre Douzou. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.) from J. chim. phys., 53: 536-41(1956). 13p.

Measurements were carried out on the initial yields (2537 A) at different pH's of the photochemical oxidation of ferrous ions. No pH effect was observed for values between 0 and 2; thus, it appears that the hypothesis, according to which atomic hydrogen, instead of reducing ferric ions in an acid medium, is transformed into H_2^+ capable of oxidizing other ferrous ions, must be discarded. Experiments carried out on a mixture of ferrous sulfate and acrylonitrile indicate that the capture of H atoms by the monomer suppresses the inverse reduction reaction, as well as the liberation of molecular hydrogen. The photochemical reduction reaction of ferrous ions (Fe^{3+} OH^- + $h\nu \rightarrow Fe^{2+}$ + OH) was observed in the presence of a monomer. This reaction results in equilibrium between the oxidation and reduction processes. There is neither oxidation nor reduction of the iron for the given ferrous and ferric ion concentration ratio, but only polymerization of the monomer. The effect of these results on the radiochemical oxidation mechanism of ferrous ions is discussed. (auth)

3036 (CEA-tr-A-1000) METHODE DE SEPARATION DE L'IODE RADIOACTIF ^{131}I. (Method of Separation of Radioactive Iodine (I^{131}). W. B. Huising, H. H. P. Moeken, and D. Nonhebel. Translated into French from German Patent 108 00 81. Apr. 21, 1960. 5p.

A method for the extraction of I^{131} from tellurium hydroxide bombarded by slow neutrons, using neither high-temperature heating nor filtration, is described. The irradiated hydroxide is suspended in acid aqueous solution. The solution is heated to a temperature between the hydration temperature of the tellurium hydroxide and the boiling point of the acid solution. The iodine is released from the hydroxide crystalline lattice and recovered from the solution by distillation. (J.S.R.)

3037 (CEA-tr-R-1377) LES RADIOÉLÉMENTS EN SOLUTIONS AUX CONCENTRATIONS EXTRÉMEMENT FAIBLES. (Radioelements in Solutions of Extremely Weak Concentrations). I. E. Starik. Translated into French from Khim. Nauka i Prom., 4: 448-56(1959). 29p.

In the review of the behavior of radioisotopes in extremely weak solutions, the methods of studying the state of microconcentrations are first described. The methods summarized are absorption, desorption, extraction, dialysis, ultrafiltration, centrifugation, electrophoresis, and radiography. The peculiarities of the radioisotope in the ionic state, molecular state, colloidal state, and pseudo-colloidal state are reviewed. (J.S.R.)

3038 (CEA-tr-X-353) PURIFICATION DE ^{90}Y PAR L'EMPLOI DE RESINES ECHANGEURS ANIONIQUES DU TYPE ACIDE CARBONIQUE. (Purification of Y^{90} Using Anion Exchange Resins of the Carbonic Acid Type). Misumi and Takeda. Translated into French from Nippon Kagaku Zasshi, 80: 1071-?(1959). 5p.

In a study of the behavior of Sr^{90} in a carbonate solution, the adsorption was measured using an equilibrium mixture of Sr^{90}–Y^{90}. It was found that Y^{90} is adsorbed whereas Sr^{90} is almost completely unadsorbed. Because of these data, an attempt was made to separate these two elements. A carbonate solution of these radioisotopes in equilibrium was passed through an exchange resin of the carbonate type. The Sr^{90} passes completely through the column, but the Y^{90} is all fixed. (J.S.R.)

3039 INFRARED SPECTRA OF POLYACRYLONITRILE POLYMERIZED G BY GAMMA-IRRADIATION AT LOW TEMPERATURES. Yoshizo Tsuda (Toyo Rayon Co., Ltd., Otsu, Japan). Bull. Chem. Soc. Japan, 34: 1046-8 (July 1961).

Acrylonitrile was polymerized in bulk and in various solutions by gamma irradiation at low temperatures, and the effects of polymerization conditions on the infrared spectrum of polyacrylonitrile were studied. The intensities of absorption bands at 1675 and 2030 cm^{-1} were found to vary according to the solvent species and the irradiation temperatures. (P.C.H.)

3040 OLFACTORY AND CHEMICAL CHANGES IN IRRADIATED ESSENTIAL OILS. H. Fazakerley, P. G. Garratt, P. R. Hills, and R. Roberts (Wantage Research Lab., Berks, Eng.). Intern. J. Appl. Radiation and Isotopes, 11: 174-83(Nov. 1961). (In English)

It has been found that the olfactory properties of a range of essential oils and isolates may be improved by small doses of radiation. At the dose most favorable to the process, no changes in the physical or chemical properties of the irradiated oils can be detected. In the case of Brazilian peppermint oil very high doses of electron or γ-radiation result in the destruction of camphene. Similar effects are noted with ultraviolet irradiation, but the disappearance of camphene is accompanied by the appearance of a new product. This product has been tentatively identified on chromatographic evidence as tricyclene, an intermediate previously encountered in the hydration and dehydration reactions involving camphene. (auth)

3041 OBSERVATION OF FREE RADICAL KINETICS IN THE CYCLOHEXANE–OXYGEN SYSTEM. R. L. McCarthy and A. MacLachlan (E. I. du Pont de Nemours & Co., Wilmington, Del.). J. Chem. Phys., 35: 1625-7(Nov. 1961).

Pulsed 6-Mev electrons from a Lineac were used to initiate free radical reactions in the cyclohexane–oxygen system. The primary radical formed, cyclohexyl, is identified through EPR analysis of the irradiated solid sample at –100°C. In the liquid phase the cyclohexyl–peroxy radical is formed; its decay is observed spectroscopically over a period of 10 msec, and the second-order rate constants calculated. The principal reaction involving the disproportionation of two cyclohexyl–peroxy radicals requires zero

(<1 kcal/mole) activation energy. The reaction rate constant is approximately 10^{-4} that for the diffusion-controlled process. (auth)

3042 ELECTRON SPIN RESONANCE STUDIES OF RADICALS FORMED IN IRRADIATED POLYTETRAFLUOROETHYLENE. Teikichi Matsugashita and Kenichi Shinohara (Japanese Assn. for Radiation Research on Polymers, Tokyo). J. Chem. Phys., 35: 1652-6(Nov. 1961).

Radicals formed in irradiated PTFE were studied by means of ESR, using reactions with gases. In interpreting the experimental results, it was assumed that the radicals formed in PTFE primarily by irradiation were $-CF_2-\dot{C}F-CF_2-$ and $-CF_2-CF_2\cdot$. The former were found to be stable, but the latter to be very reactive, at room temperature. A large part of the latter is thought to disappear by recombination, and only a small part to be oxidized by oxygen occluded in the polymer to form less reactive oxide radicals $-CF_2-CF_2-O\cdot$ even in a vacuum vessel. The radicals $-CF_2-\dot{C}F-CF_2-$ give a double quintet and $-CF_2-CF_2-O\cdot$, a triplet in the spectrum. When gaseous oxygen was admitted to the irradiated PTFE, oxygenated radicals were formed. They will be $-CF_2-(CF-OO\cdot)-CF_2-$ and $-CF_2-CF_2-OO\cdot$; the former giving asymmetrical signal termed O_I, and the latter a singlet O_{II}. The following reversible reactions were also studied: $-CF_2-\dot{C}F-CF_2- + O_2 \rightleftharpoons -CF_2-(CF-OO\cdot)-CF_2-$, and $-CF_2-\dot{C}F-CF_2- + NO \rightleftharpoons -CF_2-(CF-NO)-CF_2$. Some discussions are given on the reactions between irradiated PTFE and gases. (auth)

3043 CHEMISTRY OF POSITIVE IONS. I. GENERAL THEORY PARTICULARLY FOR THE RADIATION INDUCED CROSS LINKAGE OF POLYMERS AND POLYMERIZATION OF SATURATED HYDROCARBONS. W. F. Libby (Univ. of California, Los Angeles). J. Chem. Phys., 35: 1714-22(Nov. 1961).

The chemical properties of positive ions are considered to be analogous to those of the corresponding neutral atom or molecule. However, the charge strengthens bonds and provides the long-ranged attractive polarization force which causes the reaction cross sections to be very large. For organic ions dehydrogenation to form carbonium ions occurs frequently, so in addition to the parent ion radical with its great reactivity as a type of super fluorine atom, the carbonium ions with their extremely acidic (electrophilic) properties cause a wholly different set of reactions. These are analogous to those of carbene and may lead to the radioinduced polymerization of saturated aliphatic hydrocarbons. Both ion radicals and carbonium ions can play important roles in the radioinduced cross linkage of polyethylene and other polymers. It is predicted th t the effect of phase will be very important in radiation chemistry, because the cage effect of the surrounding close-packed molecules in the liquid and solid phase, as contrasted with the gas phase, will cause the fragmentation of the parent ions which is so marked in the gas phase to be reversed to a considerable extent and promote the formation of large molecules, particularly polymers. (auth)

3044 REMOVAL OF NIOBIUM-95 FROM ZIRCONIUM SOLUTIONS WITH VYCOR GLASS. J. G. Moore (Oak Ridge National Lab., Tenn.). J. Inorg. & Nuclear Chem., 20: 166-7(Nov. 1961). (In English)

A procedure was developed for separating Nb^{95} from zirconium nitrate–nitric acid solutions containing $Zr-Nb^{95}$ tracer by using the adsorption properties of glass. The results show that unfired Vycor glass powder will preferentially adsorb Nb^{95} from high nitric acid solutions and may be used to remove such activity from solutions containing Zr^{95} and Nb^{95}. The data are tabulated. (P.C.H.)

3045 THE EFFECT OF γ-RADIATION ON THE STI VACCINE STRAIN. G. N. Chistyakov. J. Microbiol., Epidemiol. Immunobiol. (U.S.S.R.) (English Translation), 31: 2110-13(1960).

The influence of large (up to 5 million r) and small (100 r) doses of γ-radiation emitted by Co^{60} upon the STI vaccine strain was studied. Repeated exposure of cultures grown on solid nutrient media to small doses of γ-radiation led to marked morphological changes in the bacteria easily visible under the electron microscope, which consisted in the progressive degeneration of cellular structures. Large doses of γ-radiation exerted a bactericidal effect upon the spore suspension and decreased the immunogenicity of the vaccine. Gamma radiation can be used for the disinfection of spore-bearing cultures and vaccination materials exposed to γ-radiation must be used with caution. (auth)

3046 THE PHOTOCHEMISTRY OF IODIDE ION IN AQUEOUS SOLUTION. E. Hayon (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 65: 1937-40(Nov. 1961). (BNL-5208)

The quantum yield for the formation of I_2 on exposure of air-free aqueous solutions of iodide to 2537 Å light is dependent upon the concentration of iodide and hydrogen ions, as was previously observed. In dilute solutions of iodide at pH > 3, ϕ_{I_2} is almost zero. Addition of acceptors for electrons or hydrogen atoms, such as H_2O_2 and KNO_3, brings about an iodide-induced decomposition of these scavengers in neutral and alkaline solutions. This indicates, contrary to the postulates of Farkas and Farkas and of Platzman and Franck, that hydrogen ions per se are not essential in the primary photochemical process. The dependence of ϕ_{I_2} upon $[H^+]$ may be due to the formation of H_2^+ as proposed by Rigg and Weiss, or to the scavenging of electrons by the hydrogen ions in solution $(I^- H_2O) \xrightarrow{h\nu} (I^- H_2O)^*$ and $(I^- H_2O)^* + H^+ \rightarrow I + H + H_2O$. (auth)

3047 EFFECTS OF HIGH ENERGY RADIATION ON SOME INCLUSION COMPOUNDS OF UREA, THIOUREA AND HYDROQUINONE. William Seaman (Kings Coll., Newcastle-upon-Tyne, Eng.). J. Phys. Chem., 65: 2029-33(Nov. 1961).

The following inclusion compounds were irradiated with cobalt-60 γ rays: urea with 1,4-dichlorobutane, 1-chlorododecane, 1,5-dibromopentane, 1-bromodecane, n-octadecane, sebacic acid, cetyl alcohol, and stearic acid, thiourea with 2-bromo-n-octane, dicyclohexylamine, cyclohexanol, cyclohexene, cyclohexanone, 2,3-dimethylnaphthalene, 2-methylnaphthalene, and camphene, and hydroquinone with sulfur dioxide and hydrogen sulfide. Comparisons were made with the corresponding irradiated physical mixtures in cases where the guest compounds were solid. From infrared absorption spectral evidence, explanations are suggested, based on spatial and chemical factors, for the occurrence or absence of interactions between host and guest and between components of the physical mixtures. (auth)

3048 H_2 AND C_1-C_7 YIELDS FROM THE RADIOLYSIS OF 2,2,4-TRIMETHYLPENTANE. J. A. Knight, R. L. McDaniel, R. C. Palmer, and Fred Sicilio (Georgia Inst. of Tech., Atlanta). J. Phys. Chem., 65: 2109-10(Nov. 1961).

Radiolysis products, hydrogen and hydrocarbons through C_7, from the x irradiation (50 kvp) of 2,2,4-trimethylpentane were identified and quantitative yields established by gas chromatography. Products with G ≥ 0.1, in order of decreasing yield, are hydrogen, isobutane, isobutylene, methane, 4,4-dimethyl-cis-pentene-2, propylene, neopentane, 2,2- and/or 2,4-dimethylpentane, and propane. The

radiolytic hydrocarbon products in the C_1-C_7 range can be divided into two groups. Group I consists of those products that can be related to some structural portion of the carbon skeleton of the parent molecule. There are ten such products with G values ranging from 1.6 to 0.04. Group II consists of products that cannot be related to the carbon skeleton of the parent molecule. There are seven of these products, all with low yields, with G values ranging from 0.05 to 0.003. (P.C.H.)

3049 ON A POSSIBLE TRACK REACTION IN THE RADIOLYSIS OF TOLUENE. Juerg Hoigne and Tino Gaeumann (Eidgenossische Technische Hochscule, Zurich). J. Phys. Chem., 65: 2111-12(Nov. 1961).

The dimeric products formed on gamma irradiation of liquid toluene are largely explained by reactions of radiolytically produced benzyl or tolyl radicals. The phenyltolylmethanes amount to 20% of all the dimer products formed in the main additional products. This reaction still takes place in solutions containing iodine, in a system where the benzyl radicals become scavenged (no formation of bibenzyl). Therefore it is assumed that this reaction takes place only in the spur of the ionizing electrons. (P.C.H.)

3050 THE EFFECT OF RADIATION ON COPOLYMERS OF STYRENE AND α-METHYLSTYRENE. A. M. Kotliar (Naval Research Lab., Washington, D. C.). J. Polymer Sci., 55: 71-80(Nov. 1961).

The G values for chain scission G(s) and crosslinking G(γ) processes were determined for unfractionated and fractionated polymers having 50–50 and 25–75 mole % α-methylstyrene and styrene content and are in agreement with the reported values for the respective homopolymers, corrected for mole content. These values are G(s) = 0.12, G(γ) = 0.062, G(s) = 0.10, and G(γ) = 0.094 for the 50–50 and 25–75 copolymers, respectively. The evaluation of the resulting intrinsic viscosities from the distributions computed by the Monte Carlo sampling technique in the interval, $0 < P < 10\ \bar{P}_{n,0}$, and Small's asymptotic expansion in the interval $P_{n,0} \leq P \leq \infty$ show the best correlation when g′ values (the ratio of the mean square radii of a branched to linear molecule identical in size and composition) of 0.79 and 0.72 are used for each interval, respectively. (auth)

3051 ON THE CAUSES OF PROTON TIME RELATION CHANGES IN RADIOLYSIS. Yu. N. Molin and V. K. Ermolaev (Inst. of Chemical Physics, Academy of Sciences, USSR and Inst. of Chemical Kinetics and Combustion, Siberian Branch, Academy of Sciences, USSR). Kinetika i Kataliz, 2: 358-61(May-June 1961). (In Russian)

Proton paramagnetic resonance in aqueous solutions of various organic compounds was studied during fast electron irradiation in order to determine the reason for variations in proton relaxation time during radiolysis. During hydrogen peroxide irradiation, stong variations in proton time relaxation were observed, however, signals of electron paramagnetic resonance were not found. The relaxation time changes are explained by the effects of oxygen formed in radiolysis (R.V.J.)

3052 EFFECTS OF Cd ON THE THERMAL AND RADIOCHEMICAL DISINTEGRATION OF SILVER CARBONATE. Yu. A. Zakharov, V. V. Boldyrev, and A. A. Alekseenko (Tomsk Polytechnic Inst., USSR). Kinetika i Kataliz, 2: 365-7(May-June 1961). (In Russian)

The effects of cadmium carbonate admixture (2.5 mol %) on the thermal disintegration of silver carbonate at 151°C, the effects of preliminary activation by x irradiation on the thermal disintegration process, and radiation disintegration are analyzed. It is shown that silver carbonate increased the rate of thermal and radiation disintegration. It is assumed that the increased rate is due to the deficiency in silver carbonate crystals caused by the admixture. (tr-auth)

3053 MASS SPECTROMETRIC STUDIES ON ELECTRON IMPACT FRAGMENTATION OF ETHYL HALIDES. Ignacy Złotowski and Henryk Wincel (Univ. of Warsaw). Nukleonika, 6: 409-14(1961). (In English)

Based on the analysis of the mass spectra of ethyl halide vapors used previously as a quenching gas in a GM counter, evidence was obtained to indicate that some of the decomposition products of the C_2H_5X (X = Cl, Br, I) molecules, present in the investigated vapors, form in the mass spectrometer's ion source the free radicals: $C_2H_3^+$ and $C_2H_5^+$ by the following reaction: $RH^+ + X = R^+ + HX$. The relative concentrations of the quenching gas decomposition products formed in a working GM counter were compared with the intensities of the corresponding lines in the mass spectra of the respective ethyl halide parent molecules. Some remarks are made regarding the mechanism of the decomposition of ethyl halide molecules in self-quenching counters. (auth)

3054 RADIOLYSIS OF BENZENE AND CYCLOHEXANE IN THE PRESENCE OF TETRAPHENYLCOMPOUNDS OF SILICON, GERMANIUM, TIN AND LEAD BY COBALT-60 GAMMA RAYS. W. A. Cramer. Thesis, Amsterdam, Universiteit, 1961. 79p.

Effects of small concentrations of the tetraphenyl compounds of silicon, germanium, tin, and lead on the Co^{60} gamma radiolysis of benzene and cyclohexane are investigated at room temperature in the absence of air. G-values of products are measured as functions of solute concentrations. A survey is given of some current concepts in radiation chemistry with emphasis on recent developments. Products of irradiated benzene solutions which are measured are hydrogen, acetylene, biphenyl, and phenylcyclohexadiene. The isotopic distribution of biphenyl and phenylcyclohexadiene from radiolysis of tetraphenyltin and of tetraphenyllead in completely deuterated benzene is determined. Radiosensitized decomposition of tetraphenyltin and of tetraphenyllead results in a linear increase in the yields of biphenyl and of phenylcyclohexadiene. (NPO)

3055 IMPROVEMENTS IN OR RELATING TO SILOXANE COPOLYMERS. (to Dow Corning Corp.). British Patent 883,266. Nov. 29, 1961.

Methods are given for synthesizing an organopolysiloxane gum which has good radiation resistance at high temperatures up to >200°C and may be used to make radiation-resistant rubbers. The gum is made by heating a mixture of 3 to 35 mole % diphenylsiloxane and 65 to 97 mole % phenylmethylsiloxane in the presence of an alkali metal silanolate or a low-molecular-weight siloxanolate, and then vulcanizing the resulting copolymer. The elastomer may be filled with any of the usual fillers. (D.L.C.)

3056 IMPROVEMENTS IN POLYMER EMULSIONS BY RADIOCHEMICAL GRAFTING. (to Societe Anonyme Nobel-Bozel). British Patent 883,473. Nov. 29, 1961.

A process is outlined for modifying the properties of aqueous emulsions or suspensions of high polymers of vinyl compounds, acrylic and methacrylic esters, and styrene and cellulose esters. The method comprises incorporating one or more monofunctional olefinic monomers capable of polymerization to form an aqueous emulsion, in the aqueous emulsion of the polymer and subjecting this mixture to ionizing radiations to effect grafting of the monomer on the high polymer. (D.L.C.)

3057 IMPROVEMENTS IN THE PRODUCTION OF GRAFT COPOLYMERS. (to Centre National de la Recherche Scientifique). British Patent 883,728. Dec. 6, 1961.

A process is outlined for producing graft copolymers from polyhalogenated polymers, using vinyl monomers. Previous processes resulted in only an inter-surface grafting because the monomer does not penetrate into the polymer. The present process comprises carrying out the irradiation at such a rate that the monomer is not fully consumed in a polymerization reaction before it has penetrated through the graft copolymer. This may be accomplished either by maintaining the radiation intensity at an optimum or critical value for which a maximum grafting rate occurs, or by alternating the radiation intensity at values above and below this critical value. (D.L.C.)

3058 UTILIZATION OF PROTON RECOIL ENERGY IN NEUTRON IRRADIATED VAPOUR PHASE ORGANIC REACTIONS. (to Esso Research and Engineering Co.). British Patent 883,768. Dec. 6, 1961.

A reactor is designed for the radioinduced conversion of gaseous organic materials. The reactor is of heterogeneous design, employing the organic gas as a moderator and containing fibers or strips of a material which, upon fast neutron bombardment, yields recoil protons to aid in the conversion reaction. The strips comprise organic polymers and inorganic hydrides and has a diameter of 0.5 to 20 μ. The reactor may be used for a variety of reactions, such as radio-isomerizations, radio-alkylations, radio-polymerizations, etc. An example is given in which cetane was radiopolymerized to produce a lube oil. (D.L.C.)

Raw Materials and Feed Materials

3059 (BM-RI-5884) BENEFICIATION OF URANIUM ORES. K. E. Tame and J. B. Rosenbaum (Bureau of Mines. Salt Lake City Metallurgy Research Center). Feb. 1961. 32p.

A summary of the history and state of the art of physical beneficiation of uranium ores is presented along with a detailed description of research on concentration of uranium ores by attrition grinding. Information on flotation, gravity concentration, electronic sorting, and selective grinding was gathered to complement the study of attrition grinding methods. Both dry and wet grinding procedures were investigated as potential methods of upgrading a variety of ore types, ranging in grade from 0.02 to 0.42% U_3O_8. Only sandstone-type ores proved generally amenable to concentration by attrition grinding. The degree of upgrading achieved was inversely related to the amount of friable gangue materials present in the sandstone ores. Wet grinding and classification methods yielded consistently better results than the counterpart dry procedures. (M.C.G.)

3060 (ORO-493) FUEL CYCLE DEVELOPMENT PROGRAM MONTHLY NEWSLETTER, JULY 1961. (National Carbon Co., Fostoria, Ohio). Aug. 29, 1961. Contract AT(40-1)-2560. 10p.

Studies were made of the dispersion of ThO_2 in a TS-148 mix by agglomerating in a twin-shell blender and a heated bread mixer. Extrusions of a mix consisting of Pyroclad UC_2, graphite, and a resin binder were evaluated to determine the dispersion and the effect on physical properties of large fuel particles in extruded elements. The operation of a furnace designed to study uranium migration in the conversion of UO_2 to UC_2 is described. (B.O.G.)

Separation Processes

Refer also to abstracts 3332, 3333, and 3346

3061 (BM-RI-5879) EFFECT OF TEMPERATURE IN ION-EXCHANGE SEPARATION OF RARE-EARTH ELEMENTS AND RECOVERY OF EDTA FROM EFFLUENT SOLUTIONS. R. E. Lindstrom, J. O. Winget, and J. S. Berber (Bureau of Mines. Reno Metallurgical Research Center, Nev.). Dec. 1960. 19p.

Separation efficiency of a 4% divinylbenzene (DVB) resin is not altered over a wide range in temperature. A 12% DVB resin, however, exhibits a marked sensitivity to temperature. When flow rates are high at ordinary temperatures, 4% DVB resin exhibits higher efficiency, but at 200°F both resins are equal in performance. Effective separation of rare-earth mixtures may be obtained with hydrogen as a retaining ion by maintaining column temperatures above the solubility of ethylenediaminetetraacetic acid (EDTA) in the free acid form. Slightly lower separation characteristics were obtained with this method as compared with copper as a retaining ion. Recovery of 99% of the EDTA from spent eluting solutions that contain copper has been accomplished by a calcium–copper displacement reaction followed by EDTA precipitation. Impurities in the product are correspondingly low. Recoveries of EDTA from holmium solutions with sulfuric acid are substantial; however, those from yttrium solutions are quite modest. Radiotracer experiments show the presence of approximately 0.1% yttrium contamination in the recovered material. (auth)

3062 (DP-646) ABSORPTION SYSTEM FOR RADIOACTIVE IODINE. Albert E. Symonds, Jr. (Du Pont de Nemours (E. I.) and Co. Savannah River Lab., Aiken, S. C.). Sept. 1961. Contract AT(07-2)-1. 11p.

An apparatus containing a zeolite molecular sieve was designed to absorb free radioactive iodine from ruptured uranium oxide fuel elements in a facility for experimental examination of the fuel. (auth)

3063 (IDO-14562) MIXING AND EVAPORATION IN A PACKED VESSEL. C. K. Cederberg and J. A. Buckham (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Sept. 20, 1961. Contract AT(10-1)-205. 32p.

In connection with an evaluation of the operability of a 36-inch diameter remote evaporator at the Idaho Chemical Processing Plant that was to be packed with a corrosion-resistant neutron-poison packing for criticality control, an investigation in a 30-inch diameter vessel proved that air sparging effectively mixes solutions. The data showed that at similar sparge rates the presence of the packing caused an increase in the time needed for complete mixing. The investigation showed that solutions are readily evaporated in spite of the presence of packing in the tank. (auth)

3064 (IDO-16732) THE GAS-SOLID CHROMATOGRAPHIC SEPARATION OF POLYPHENYLS ON LITHIUM CHLORIDE–FIREBRICK. A. J. Moffat and P. W. Solomon (Phillips Petroleum Co. Research and Development Dept., Bartlesville, Okla.). Nov. 10, 1961. Contract AT(10-1)-1080. 14p.

A gas-solid chromatographic technique was developed for the separation of polyphenyls. Various mixtures of terphenyls, quaterphenyls, quinquephenyls, hexaphenyls, heptaphenyls and octaphenyls were successfully resolved. The column packing which was used is firebrick impregnated with lithium chloride (20% by weight). The principal characteristics of this immobile phase are: excellent high temperature stability (> 500°C), no bleeding and thus better

baseline stability than stationary liquids, and better resolution for polyphenyls and longer column life at high temperatures than is normally obtained using stationary, organic liquid phases. (auth)

3065 (MCW-1469) PROCESS DEVELOPMENT QUARTERLY PROGRESS REPORT, JULY–SEPTEMBER 1961. (Mallinckrodt Chemical Works. Uranium Div., Weldon Spring, Mo.). Nov. 1, 1961. Contract W-14-108-Eng-8. 43p.

A fluid-bed reduction reactor with a production capacity in excess of 50 pounds UO_2 per hour was installed. The single unit is baffled to permit continuous "two-pass" operation. Laboratory work on the electrolytic production of uranium metal was continued. The mechanism of formation of an electrically conducting layer at the electrolyte surface was studied, and effective means for preventing its formation were developed. Improved means for preparing UO_2-carbon anodes and better techniques for suppressing CF_4 formation were also developed. A phase study of the BaF_2–UF_4 system revealed a eutectic mixture melting at 725 ± 10°C and a peritectic compound that decomposes at 870 ± 10°C. Laboratory work on a simple process for recovering uranium from magnesium fluoride slag was completed. Efficient uranium recovery can be achieved by a nitric acid leach of ground slag followed by solvent extraction of the leach liquor in the existing refinery. A heat treating process was devised that will produce structures suitable for reactor fuel in gamma-extruded rods of alloyed and unalloyed dingot uranium. The heat treatment consists of a prolonged alpha anneal followed by a standard beta heat treatment (auth)

3066 (ORNL-3065) ZIRCEX AND MODIFIED ZIRFLEX PROCESSES FOR DISSOLUTION OF 8% U–91% Zr–1% H TRIGA REACTOR FUEL. T. A. Gens (Oak Ridge National Lab., Tenn.). Nov. 30, 1961. Contract W-7405-eng-26. 25p.

Processes were developed in the laboratory for recovery of uranium from spent TRIGA fuel (8% U–91% Zr–1% H, clad in aluminum, graphite moderator plugs) by gas-phase hydrochlorination (Zircex process) at 300 to 800°C to separate $ZrCl_4$ from the less volatile uranium chlorides and for dissolution of the fuel in 5.4 M NH_4F–0.33 M NH_4NO_3–H_2O_2 (modified Zirflex process). After nitric acid addition, solvent extraction feed solutions containing 0.1 and 0.0085 M uranium, for the respective processes, are obtained. To decrease corrosion during recovery of uranium by solvent extraction in stainless steel equipment, chloride is distilled from the Zircex product and aluminum nitrate is added to the modified Zirflex product. The uranium chloride product from the Zircex process may be dissolved in nitric acid or it may be fluorinated at 200°C to produce uranium hexafluoride. The aluminum cladding and graphite plugs are removed by hydrochlorination and burning, respectively, in the Zircex process and by dissolution in caustic solution and disintegration in cold fuming nitric-sulfuric acid mixtures, respectively, in the modified Zirflex process. (auth)

3067 (ORNL-3186) PROCESSES FOR RECOVERY OF URANIUM AND THORIUM FROM GRAPHITE-BASE FUEL ELEMENTS. PART II. L. M. Ferris, A. H. Kibbey, and M. J. Bradley (Oak Ridge National Lab., Tenn.). Nov. 30, 1961. Contract W-7405-eng-26. 37p.

Laboratory-scale tests on methods for recovering uranium and thorium from graphite-base reactor fuel elements are reported. The 90% HNO_3 process, which involves simultaneous disintegration and leaching in 21 M HNO_3, is applicable to all fuel elements which do not contain coated fuel particles. Leaching of irradiated (0.001% burnup) fuels containing 3 and 12% uranium recovered ~99.3 and 99.9%, respectively, of the uranium in two 4-hr leaches with boiling acid. The graphite residue retained >50% of the long-lived fission products. Three successive leaches of fuel containing uranium and thorium recovered ~99% of both elements. Uranium recoveries by combustion in oxygen followed by dissolution of the ash in nitric acid or fluoride-catalyzed nitric acid are quantitative only when the fuel is not coated, does not contain Al_2O_3-coated fuel particles, and is free from impurities such as iron. During combustion up to 95% of the Ru-106 was volatilized from irradiated specimens. Recoveries, by leaching with 70% HNO_3, from fuel specimens containing Al_2O_3-coated fuel particles were greater than 99% when the specimens were ground finer than 200 mesh to ensure crushing of the fuel particles. (auth)

3068 (ORNL-3228) ADSORPTION OF KRYPTON AND XENON BY VARIOUS MATERIALS. M. H. Lloyd and R. A. McNees (Oak Ridge National Lab., Tenn.). Dec. 1, 1961. Contract W-7405-eng-26. 21p.

The adsorptive capacities of various inorganic adsorbents and activated charcoals for krypton and xenon were determined. Columbia-G activated charcoal had the highest capacity for both krypton and xenon at pressures from 0.01 to 125 mm Hg and temperatures from 2 to 85°C. If a value of 1 is assigned to the capacity of this charcoal at 28°C for krypton, other charcoals range from 0.63 to 0.84, molecular sieves (except 4A) from 0.11 to 0.20, and some silica gels from 0.05 to 0.07. Various other adsorbents, including one variety of silica gel and molecular sieve 4A, range from 0.005 to 0.032. Molecular sieve 5A and Columbia-G charcoal adsorbed 11.5 times more xenon than krypton. Adsorption of 7.5% water by either of these adsorbents lowered their capacity for krypton 25 to 30%, while saturating the sieve material (~15% H_2O) lowered the krypton capacity 80%. (auth)

3069 (PAN-236/V) TRENNUNGEN DER SELTENEN ERDEN IN FORM IHRER KOMPLEXE MIT ÄTHYLENDIAMINTETRAESSIGSÄURE AN ANIONENAUSTAUSCHERN. (Separation of the Rare-Earth-EDTA-Complexes on Anion Exchange Columns). M. Wald (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). June 1961. 21p.

The possibility is shown of separating the rare earths, either in groups or individually, as complexes with EDTA on anion exchange columns. The method makes it possible to separate the rare earths from thorium. The relation between the distribution coefficient and the concentration of eluants is discussed. (auth)

3070 (AEC-tr-4674) EFFECT OF TEMPERATURE ON THE EXTRACTION OF URANYL AND PLUTONIUM NITRATES AND OF NITRIC ACID BY TRIBUTYL PHOSPHATE. A translation of "Vliyanie Temperatury na Ekstraktsiyii Tributilfosfatom Nitratov Uranila, Plutoniya i Azotnoi Kisloty." V. B. Shevchenko, I. A. Fedorov, and Yu. P. Agureev (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 18p.

The basic experimental data concerning the effect of temperature on the extraction of uranyl and plutonium nitrates and of nitric acid by tributyl phosphate solutions in saturated, high-boiling hydrocarbons are presented. The dependence of the equilibrium constants on the temperature were determined. It was found that with increasing temperature the extractability of the uranyl nitrate and of nitric acid diminishes; in the case of plutonium nitrate the temperature dependence presents a more complicated

behavior. The values of the thermodynamic functions ΔH, ΔZ, and ΔS for the extraction of uranyl and plutonium nitrates and of nitric acid are listed. (auth)

3071 SEPARATION OF TRACES OF INORGANIC IONS FROM AQUEOUS SOLUTIONS BY GAS-, LIQUID- AND SOLID-PHASE DISTRIBUTION PROCEDURES. T. S. West (Birmingham Univ., Eng.). Anal. Chim. Acta, 25: 405-21 (Nov. 1961). (In English)

A review is given on the three separation methods. Most of the procedures discussed are valid for μg (10^{-6} g) amounts, and a considerable number also for millimicrogram (10^{-9} g) or smaller amounts. 52 references are given to books and to U. S. and foreign journals. (P.C.H.)

3072 SEPARATION BY VOLATILIZATION OF THE RADIOISOTOPES OF PLATINUM, IRIDIUM, OSMIUM AND RHENIUM FORMED BY BOMBARDMENT OF A GOLD TARGET. Jean Merinis and Georges Bouissières (Institut du Radium, Paris and Laboratoire de Physique Nucléaire, Orsay, France). Anal. Chim. Acta, 25: 498-504 (Nov. 1961). (In French)

The radioactive isotopes of mercury, platinum, iridium, osmium, and rhenium, products of bombardment processes in gold irradiated with protons at 150 Mev, are separated cleanly by distillation in a stream of argon or chlorine and by condensation in a tube possessing a temperature gradient. (auth)

3073 DISTRIBUTION OF VARIOUS ELEMENTS BETWEEN NITRIC ACID AND ANION EXCHANGE RESIN. Fujio Ichikawa, Shinobu Uruno, and Hisashi Imai (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 34: 952-5(July 1961).

Distribution coefficients of some 58 metallic elements, from sodium through neptunium, between nitric acid and anion exchange resin were measured and are shown in a periodic table. From the results obtained, the fundamental data on the separation of each element in nitric acid were determined. (P.C.H.)

3074 THE USE OF AMMONIUM PHOSPHOTUNGSTATE FOR THE ION-EXCHANGE SEPARATION OF RUBIDIUM AND CESIUM. V. Kourzhim, A. K. Lavrukhina, and S. S. Rodin (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, SSSR). Doklady Akad. Nauk S.S.S.R., 140: 832-4(Oct. 1, 1961). (In Russian)

A tremolithic asbestos belonging to the amphibole group was found to perform better than silica gel, glass wool, cellulose or cork in preparing a column impregnated with ammonium phosphotungstate for the separation of Cs and Rb. A glass column 5 mm internal diameter and 30 mm high was filled with an asbestos suspension in 1 M NH_4NO_3. The column was then treated with a 0.2 M solution of phosphotungstic acid followed by a 0.3 M solution of NH_4NO_3. The phosphotungstate salt formed is retained strongly by the asbestos fibers. The Rb^{86} and Cs^{134} tracers were adsorbed onto the column from a 1.0 M HNO_3 solution. The Rb^{86} tracer is first eluted with 1.0 M NH_4NO_3, and Cs^{134} is eluted with a 6.0 M NH_4NO_3 solution. A clear separation of Rb and Cs is obtained in 40 to 45 minutes. Cs and Rb can also be separated by impregnating the column with ammonium silicomolybdate, but since this salt is more soluble in NH_4NO_3 solution than ammonium phosphotungstate, it is slowly removed from the column during elution. Ammonium silicotungstate was also found to be unsuitable because of its high solubility in ammonium nitrate solutions. (TTT)

3075 RADIOCHEMICAL STUDIES ON THE SOLVENT EXTRACTION OF INORGANIC IONS WITH DODECYLBENZENESULFONIC ACID, (III). EXTRACTION OF NEPTUNIUM (IV), (V), AND (VI). Eiko Nakamura (Japan Atomic Energy Research Inst., Tokyo). J. At. Energ. Soc. Japan, 3: 684-7(Sept. 1961). (In English)

The solvent extraction behavior of Np(IV), (V), and (VI) was surveyed in the systems dodecylbenzenesulfonic acid-dilute hydrochloric, nitric, and perchloric acid, together with the behavior of U(VI), thorium, protactinium, zirconium, hafnium, and niobium for comparison. The behavior found for Np(IV), (V), and (VI) was assigned to that for quadrivalent, univalent, and bivalent cationic species respectively, and in this respect resembled that for thorium, niobium, and uranium. Therefore, it was deduced that the ionic species Np^{4+}, NpO_2^+, and NpO_2^{2+} should exist for neptunium in dilute acid solutions. The similarity between Np(IV) and thorium and Np(VI) and U(VI) was confirmed. Np(V), however, was found to behave differently from protactinium. (auth)

3076 SOLVENT EXTRACTION BEHAVIOR OF INORGANIC IONS IN THE ALKYLAMINES-HYDROCHLORIC ACID SYSTEMS. AMBERLITE LA-1 AND TRI-ISO-OCTYLAMINE. Tomitaro Ishimori (Japan Atomic Energy Research Inst., Tokyo), Hassan M. Sammour, Kan Kimura, Hiroko Murakami and Tomiko Izumi. J. At. Energ. Soc. Japan, 3: 698-704(Sept. 1961). (In English)

The extraction behavior of more than 60 chemical elements in the systems of 10% Amberlite LA-1 xylene solution-hydrochloric acid and 5% tri-iso-octylamine xylene solution-hydrochloric acid is presented and discussed, the acidity being varied from 1 to 12M. The distribution ratio, K_d, of the particular nuclide is determined by the use of radioactive tracer. Although the shapes of the acid dependence curves for each element resemble each other in the two systems, the K_d values in the TIOA system are generally higher than those obtained in Amberlite LA-1. The same regularity is noticed for the relationship between the K_d values of the elements at a definite acidity and their respective atomic number, Z, in the two systems examined. By comparison with the TBP-HCl or the anion exchange resin-HCl systems, it is found that amines give acid and Z dependence curves quite analogous to those of the two former systems. The higher K_d values for scandium and heavier rare earth elements in the TBP-HCl system are, however, a rare exception. (auth)

3077 SEPARATION OF YTTRIUM-90 FROM STRONTIUM-90 AND LANTHANUM-140 FROM BARIUM-140 WITH ANION EXCHANGE RESIN OF CARBONATE FORM. S. Misumi and T. Taketatsu (Kyushu Univ., Fukuoka). J. Inorg. & Nuclear Chem., 20: 127-30(Nov. 1961). (In English)

The separation of yttrium-90 from strontium-90 or lanthanum-140 from barium-140 was carried out with an anion exchange resin in the carbonate form. It was found possible to obtain carrier-free yttrium-90 or lanthanum-140 efficiently. Moreover it is possible to separate yttrium-90 repeatedly from the carbonate solution by this method. (auth)

3078 EXTRACTION OF GROUP VIII METALS BY LONG CHAIN ALKYL AMINES. II. COBALT(II)–HYDROCHLORIC ACID SYSTEMS. M. L. Good and S. E. Bryan (Louisiana State Univ., New Orleans). J. Inorg. & Nuclear Chem., 20: 140-6(Nov. 1961). (In English)

The extraction of Co(II) from hydrochloric acid solutions by long chain alkyl amines in various organic solvents was studied using tracer techniques. The extraction curves obtained exhibit a maximum between 8.5 and 10.5M hydrochloric acid and are analogous to previously reported ion

exchange resin elution curves of certain divalent metals. The effects of solvent and amine structure on the extraction of Co(II) were investigated. Spectrophotometric studies were made on the aqueous Co(II) solutions at high hydrochloric acid concentrations and on the extracted cobalt species in the organic phase. The results of this investigation lend support to the conclusion that the extracted cobalt species is the $CoCl_4^{2-}$ complex. (auth)

3079 ORGANIC EXTRACTION FROM FUSED URANIUM CHLORIDES. M. Taube and Z. Borkowska (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nature, 192: 745-6(Nov. 25, 1961).

Organic extraction from fused salts was investigated using a 1.5 wt % UCl_4 solution in a eutectic mixture of KCl - CuCl (molar ratio 1:2) as the salt phase, and a solution of trioctylamine, tributyl phosphate, or dibutyl phosphoric acid in diphenyl as the organic phase. The distribution ratios between organic and salt phases were measured for labeled Cu, K, and Cl and enriched U. The results indicate that Cu and U are extracted as the respective anions $Cu_2Cl_3^-$ and UCl_5^-. (D.L.C.)

3080 CHEMICAL FEASIBILITY OF NUCLEAR POISONS IN URANIUM–THORIUM FUEL PROCESSING SYSTEMS. J. G. Moore and R. H. Rainey (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng., 11: 278-84(Nov. 1961).

Laboratory experiments have demonstrated the chemical feasibility of incorporating soluble salts of the neutron poisons boron, cadmium, samarium, and gadolinium in solutions associated with the processing of reactor fuel (stainless steel-clad 96% ThO_2-4% highly enriched UO_2). At room temperature at least 0.3 M boron or neutron cross section equivalent is soluble in the 6 M H_2SO_4 decladding solution or Thorex dissolvent (13 M HNO_3-0.04 M F-0.1 M $Al(NO_3)_3$. None of the poisons were volatilized to a significant extent (i.e., <6%) during evaporation for fuel adjustment. Distribution coefficients obtained in batch extraction tests indicated low extraction of these nuclear poisons from nitrate solutions by TBP in Amsco. Single-cycle countercurrent batch extractions with the acid Thorex flowsheet, which used 30% TBP, gave decontamination factors from uranium for boron, cadmium, and rare earths of $\geq 1 \times 10^4$, $>1.5 \times 10^3$, and $>10^4$, respectively. Countercurrent batch extractions with 2.5% TBP in Amsco resulted in concentrations of boron, rare earths, and cadmium in the uranium product which were at the limits of analytical detection, i.e., 2.5, <4, and <17 ppm, respectively. Two cycles of extraction should decrease the concentration of the nuclear poisons to acceptable levels for fuel recycle. (auth)

3081 SEPARATION OF IODIDES, IODATES AND PERIODATES BY THE PAPER CHROMATOGRAPHY. Aleksander Halpern (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 6: 107-11 (1961). (In English)

The separation of iodides, iodates, and periodates by the paper chromatography with different eluants and filter paper was investigated. Presence of a large amount of tellurite in the mixture does not influence the separation. The substance on the chromatograms was identified by the chemical or radiometrical method. In the second case two Geiger-Mueller counters with conjugated anodes were used for the measurements of radioactivity of paper strips. (auth)

3082 THE INVESTIGATIONS ON THE POSSIBILITY OF RECOVERY OF OTHER PRECIOUS METALS OCCURRING TOGETHER WITH URANIUM IN ORES. Karol Pinkas (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 6: 127-33(1961). (In Polish)

The simultaneous recovery of uranium and copper by the sulfuric acid-ferric sulfate leaching of domestic carbonaceous uranium ore is found. The copper is precipitated from the sulfuric acid solution by means of iron or zinc scrap. The proposed ore flowsheet incorporates: the sulfuric acid-ferric sulfate ore leaching, the cement-copper precipitation, and separation of uranium from solution by amine extraction. The method decreases the production costs of the sodium diuranate and shows the recovery possibility of other precious metals. (auth)

3083 SEPARATION OF THE RARE EARTH ELEMENTS–EDTA–COMPLEXES ON ANION EXCHANGE RESINS. Maksymilian Wald (Inst. of Nuclear Research, Warsaw). Nukleonika, 6: 475-88(1961). (In Polish)

The possibility of separating rare earths, either in groups or individually, as complexes with EDTA on anion exchange columns, is demonstrated. The method renders it possible to separate the rare earths from thorium, too. The relation between the distribution coefficient and the concentration of eluants is discussed. (auth)

3084 GENERAL REMARKS ON SYNERGIC EFFECTS IN THE EXTRACTION OF URANIUM AND PLUTONIUM COMPOUNDS. Sławomir Siekierski and Mieczysław Taube (Inst. of Nuclear Research, Warsaw). Nukleonika, 6: 489-501(1961). (In English)

Classification of extraction systems containing mixtures of two extracting agents is proposed. The definition of the synergic effect is introduced and the partial synergic (positive and negative) mechanisms are discussed. The possible synergic (positive) and antagonistic systems for 6 mixtures of two extractants are discussed. In these mixtures each extractant belongs to one of the three groups: anionic, non-ionic and cationic. The definition of the synergic coefficient $S = \log (D_{1,2,exp}/D_{1,2,add})$ is introduced. In this equation, $D_{1,2,exp}$ denotes partition ratio measured experimentally, and $D_{1,2,add}$ denotes partition ratio calculated on the basis of additivity. (auth)

3085 SEPARATION OF RARE EARTHS FROM TANTALUM. O. V. Larionov and M. K. Nikitin. Vestnik Leningrad. Univ., 16: No. 10, Ser. Fiz. i Khim. No. 2, 73-6 (1961). (In Russian)

Experiments demonstrating quantitative separation of rare-earth traces from hafnium and tantalum are described, cation exchange resin in hydrofluoric acid medium being used. (auth)

3086 THE USE OF THE ANION EXCHANGER EDE-10 IN HYDROXYL FORM IN SEPARATING LANTHANUM FROM THE RARE EARTHS. A. I. Ryabinin and Yu. A. Koz'min (All-Union Scientific Research Inst., USSR). Zhur. Priklad. Khim., 34: 1907-11(Sept. 1961). (In Russian)

A neutral rare earth solution (pH = 5) containing 20 and 40 g/l rare earths (4 grams total) as nitrates was mechanically stirred 2, 5 and 7 hours with 40 to 70 ml of anion exchanger in the hydroxyl form. The nitrate anion releases hydroxyl anion from the resin which precipitates the rare earths selectively according to basicity. Pr and Nd precipitate first, while La remains in solution. A 70% yield of La having a purity of 98 to 98.5% can be obtained from a rare earth mixture containing 65 to 70% lanthanum oxide. An increase in temperature has an unfavorable effect on the separation. A volume of 800 ml of anion exchanger was contacted with six successive portions each containing 70 grams of mixed rare earth oxides (about 30% Pr + Nd), and

agitated for five hours each time at room temperature. The results showed that the separation of La from Nd and Pr was excellent. It is believed that the formation of a basic rare earth precipitate around the kernels of the anion exchanger slowed down the diffusion of hydroxyl ions into the solution and resulted in a cleaner separation. (TTT)

3087 PROCESS FOR THE PURIFICATION OF THORIUM OXIDE. Wilhelm Geilmann, Arnold Spang, and Werner Gebauhr (to Siemens-Schuckertwerke A. G.). British Patent 882,551. Nov. 15, 1961.

A process is outlined for purifying ThO_2 for use as reactor fuel. The process comprises passing a current of O_2 or air over ThO_2 at 1200 or 1500°C, and then passing a current of a reducing gas (H_2 or CO) over the ThO_2 at 1200 or 1500°C. The oxidation treatment removes as volatile oxides any B, Ir, Re, W, Os, Mo, Ru, or V, 1200°C being used in the absence of V and 1500°C in its presence. The reduction treatment removes any Cd, Hg, In, Se, Sb, Te, As, Tl, Ga, Zn, Pb, Bi, or Po, 1500°C being used if Ag, Ge, or Sn is also to be removed. Either of the two treatments may be omitted if not required to purify the ThO_2. (D.L.C.)

3088 IMPROVEMENTS IN OR RELATING TO APPARATUS AND METHOD FOR LIQUID-LIQUID EXTRACTION. Alan Arthur North, Arnold Audsley, Alan David Sperrin, and Gervaise Luigi Milward (to United Kingdom Atomic Energy Authority). British Patent 883,388. Nov. 29, 1961.

An apparatus is designed for contacting two immiscible liquids of different specific gravities. The apparatus comprises a container with an axial shaft adapted to be rotated, a plurality of discs mounted on the shaft, and fixed separators secured to the container between the discs. Separate inflow and outflow means are provided for the two liquids. The discs are made out of a material preferentially wetted by the heavier liquid, so that the discs, upon rotation, carry films of the heavier liquid into the lighter liquid. Thus, the liquids are contacted more fully without the dispersion of one liquid in the other. The apparatus may be designed with a plurality of horizontal shafts and was found useful for the extraction of uranium from aqueous pulps. (D.L.C.)

3089 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR CONCENTRATING SOLUTIONS, ESPECIALLY SOLUTIONS CONTAINING FISSIONABLE MATERIAL. John Lindley (to United Kingdom Atomic Energy Authority). British Patent 883,447. Nov. 29, 1961.

An apparatus for concentrating solutions of fissionable material is designed with means for inducing circulation. The apparatus comprises a slab-shaped vessel with one dimension small enough to prevent criticality. The vessel volume is divided into two legs interconnected by passages at top and bottom, a liquid inlet and draw-off means opening into one leg and a heater associated with the other leg, whereby convective circulation can be established between the two legs. A vapor outlet with means for disentrainment of liquid from the escaping vapor is provided above the liquid. The change in liquid concentration is monitored by pneumercator tubes. (D.L.C.)

3090 SEPARATION OF URANIUM AND PLUTONIUM OXIDES. Glen E. Benedict and Ward L. Lyon (to U. S. Atomic Energy Commission). U. S. Patent 3,011,865. Dec. 5, 1961.

A method of separating a mixture of UO_2 and PuO_2 is given which comprises immersing the mixture in a fused NaCl–KCl bath, chlorinating with chlorine or phosgene, and preferentially electrolytically or chemically reducing the UO_2Cl_2 so produced to UO_2 and filtering it out. (AEC)

3091 DISSOLUTION OF ZIRCONIUM-CONTAINING FUEL ELEMENTS. F. L. Horn (to U. S. Atomic Energy Commission). U. S. Patent 3,012,849. Dec. 12, 1961.

Uranium is recovered from spent uranium fuel elements containing or clad with zirconium. These fuel elements are placed in an anhydrous solution of hydrogen fluoride and nitrogen dioxide. Within this system uranium forms a soluble complex and zirconium forms an insoluble complex. The uranium can then be separated, treated, and removed from solution as uranium hexafluoride. (AEC)

3092 SEPARATION OF SCANDIUM VALUES FROM IRON VALUES BY SOLVENT EXTRACTION. Carl W. Kuhlman, Jr. and Gerhard P. Lang (to U. S. Atomic Energy Commission). U. S. Patent 3,013,859. Dec. 19, 1961.

A process is given for separating scandium from trivalent iron values. In this process, an aqueous nitric acid solution is contacted with a water-immiscible alkyl phosphate solution, the aqueous solution containing the values to be separated, whereby the scandium is taken up by the alkyl phosphate. The aqueous solution is preferably saturated with magnesium nitrate to retain the iron in the aqueous solution. (AEC)

3093 A PROCESS FOR SEPARATING AZEOTROPIC MIXTURES BY EXTRACTIVE AND CONVECTIVE DISTILLATION. Jack W. Frazer (to U. S. Atomic Energy Commission). U. S. Patent 3,013,953. Dec. 19, 1961.

A method is described for separating an azeotrope of carbon tetrachloride and 1,1,2,2-tetrafluorodinitroethane boiling at 60°C. The method comprises, specifically, feeding azeotrope vapors admixed with a non-reactive gas into an extractive distillation column heated to a temperature preferably somewhat above the boiling point of the constant boiling mixture. A solvent, di-n-butylphthalate, is metered into the column above the gas inlet and permitted to flow downward, carrying with it the higher boiling fraction, while the constituent having the lower boiling point passes out of the top of the column with the non-reactive gas and is collected in a nitrogen cold trap. Other solvents which alter the vapor pressure relationship may be substituted. The method is generally applicable to azeotropic mixtures. A number of specific mixtures which may be separated are disclosed. (AEC)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

3094 (AERE-M-941) AN ELECTROMAGNETIC STIRRER FOR GLOVE BOX USE. K. W. Bagnall and P. S. Robinson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Oct. 1961. 6p.

An electromagnetic stirrer which has no moving part other than the polythene-encased rotor was designed for use in glove boxes. (auth)

3095 (DP-649) GAUGE FOR MEASURING DIAMETERS OF IRRADIATED ELEMENTS. Charles E. Jackson (Du Pont de Nemours (E. I.) and Co. Savannah River Lab., Aiken, S. C.). Oct. 1961. Contract AT(07-2)-1. 8p.

A remotely operated mechanical gage was designed to measure the outside diameter of irradiated fuel tubes and rods. The gage was used successfully for over a year in a hot cell at the Savannah River Laboratory. (auth)

3096 (NYO-9645) FINAL REPORT ON ATOMIC ENERGY COMMISSION BLOOD CELL SCANNER. K. Preston, Jr. and N. F. Izzo (Perkin-Elmer Corp., Norwalk, Conn.). Sept. 12, 1961. Contract AT(30-1)-2573. 49p. (PE-TR-5987)

The application of the television microscope scanner, scanner-computer link, and special purpose computer to the problem of imaging individual white blood cells, quantizing their images, storing same in computer memory, and applying thereto the Golay shrink process is described. Approximately 100 white blood cells were selected as a weighted sample of the white cell population of peripheral blood. Using the shrink process, the CELLSCAN demonstrator was able to properly identify 92% of all granulocytes in this sample, 83% of the binucleate lymphocytes, and 5 of the 7 lymphocytes. The two monocytes selected were classified as granulocytes. Methods for improving the accuracy of the CELLSCAN system by changes in sample preparation and in computer logic are described. A section giving the parameters of a practical laboratory instrument and possibilities for future development is also included. (auth)

3097 (ORNL-3197) RECORDING EQUIPMENT FOR INTERNAL FRICTION MEASUREMENTS. R. L. Stephenson and H. E. McCoy, Jr. (Oak Ridge National Lab., Tenn.). Oct. 31, 1961. Contract W-7405-eng-26. 13p.

An apparatus was developed for recording internal friction data in such a manner as to circumvent many of the laborious and time-consuming observations and calculations usually associated with these measurements. An optical lever is used and the passage of the beam across the scale is detected by photoconductive cells. The cells are strategically located so that, when their signals are fed through a multichannel switching circuit to the pens of an operation recorder, a plot of the logarithm of the vibrational amplitude versus the number of cycles is recorded on the chart. From the definition of the logarithmic decrement, (δ), it can be shown that the slope of this curve is $-\delta$. The apparatus is inexpensive and requires a minimum of maintenance. It has been used for accurate determinations of values of δ from below 0.0001 up to 0.3. (auth)

3098 (ORNL-3217) A LARGE-SCALE GETTER PUMPING EXPERIMENT USING VAPOR DEPOSITED TITANIUM FILMS. R. E. Clausing (Oak Ridge National Lab., Tenn.). Nov. 7, 1961. Contract W-7405-eng-26. 28p.

The use of titanium getter pumping for large vacuum systems is described. Techniques were developed which give sorption rates approaching the maximum theoretically possible for many of the chemically active gases. A simple method of determining sticking fractions is described. Sticking fractions for hydrogen, deuterium, oxygen, nitrogen, carbon monoxide, carbon dioxide, and methane are given for various films. The capacity and sorption characteristics for these films are shown. Simple and reliable resistance-heated titanium evaporators are described. It was demonstrated that the pumping methods described provide outstanding performance and are both reliable and practical. (auth)

3099 (ORNL-TM-63) DEVELOPMENT OF CENTRIFUGAL COMPRESSORS. I. K. Namba (Oak Ridge National Lab., Tenn.). Oct. 9, 1961. Contract [W-7405-eng-26]. 10p.

Coolant flow for gas-cooled in-pile loops must be supplied during irradiation test runs. A centrifugal compressor has been designed and developed for circulating helium at volume flows from 75 to 250 acfm at compressor suction conditions of 400 psi and 600°F. The compressor using grease-lubricated ball bearings has operated satisfactorily for a total of 3500 hr. (auth)

3100 (TID-4100(1st. Rev., Suppl. 14)) SUPPLEMENTAL INSERT SHEETS FOR ENGINEERING MATERIALS LIST. Richard E. C. Duthie, ed. (Division of Technical Information Extension, AEC). Sept. 1961. 34p.

Included are lists under computers, engineering equipment, hot laboratory equipment, instruments, metallurgical equipment and processes, nuclear radiation instruments, nuclear reactors and facilities, radiation source units, research equipment, rockets and missiles, shielded containers, and waste disposal equipment. (J.R.D.)

3101 (TID-14183) BACK DIFFUSION IN LABYRINTH SEALS. H. C. Sanderson (Oak Ridge Gaseous Diffusion Plant, Tenn.). Oct. 23, 1961. Contract [W-7405-eng-26]. 15p. (KL-1188).

Experiments were conducted to determine the conditions under which back diffusion would occur in positive clearance seals of the labyrinth type and to set safe operating conditions for the seal. The experiments were run with air or helium as the process gas and with water as the buffering fluid. There was no indication of back diffusion of water vapor across the gas seal with pressure differences between process and seal exhausts of 10 to 0.1 psi and seal temperatures of 80 and 500°F. This result is in agreement with the theoretical study by H. L. Weissberg. (D.L.C.)

3102 (TID-14229) SUSPENSION OF SOLIDS BY MIXING IMPELLERS. Progress Report. (Purdue Univ., Lafayette, Ind.). Oct. 1961. Contract AT(11-1)-804. 80p.

The conditions required for suspension of various weight percents of three size ranges of glass beads in liquids of different densities and viscosities were studied in three sizes of tanks using geometrically similar mixing impellers and three impeller positions. Comparisons were made for flat-blade turbine impellers and fan turbine impellers. The speed necessary to suspend all solids was found to be a function of the variables as shown in the equation: $N_c = KD^{a'}(T/D)^b(d/D)^c(C/D)^e W^f(\Delta\rho/\rho_L)^h\rho_L^i\mu^j$, where N_c is the impeller speed just necessary to lift all solids from the

tank bottom, D is the impeller diameter, T is the tank diameter, d is the average solids diameter, C is the height of the impeller above the tank bottom, W is the weight percent solids, ρ_L is the density of the liquid (or the specific gravity, $\Delta\rho$) is the difference between solid and liquid specific gravities, and μ is the liquid viscosity. The point of complete suspension was determined by a light transmittance technique. The exponents in the equation were constant, and gave the following result:

$$N_c = 65D^{-0.45}(T/D)^{0.25}(d/D)^{0.2}(C/D)^{0.5}W^{0.1}(\Delta\rho/\rho_L)^{0.3}\rho_L^{-0.3}\mu^{-0.02}.$$

The equation applies over rather wide ranges of the variables. The effects of geometric changes in the system on the ability of the system to suspend solids were illustrated through a power per unit volume equation which gives:

$$P_c/V = 0.05D^{0.65}(T/D)^{-2.25}(d/D)^{0.6}(C/D)^{1.5}W^{0.3}(\Delta\rho/\rho_L)^{0.3}\rho_L^{0.1}\mu^{-0.06},$$

and this applies to a tank size scale-up from 9 to 18 in., or a ratio of 1 to 3. The power requirements for a fan turbine were found to be less in most cases than those of a flat-blade turbine for solid-liquid systems. Also, over the ranges studied there appears to be no significant difference in power required to rotate the impellers in pure liquid or in liquids containing solids. (auth)

3103 POSSIBILITIES OF RADIATION PYROMETRY IN THE BLUE-VIOLET AND ULTRAVIOLET REGIONS OF THE SPECTRUM. D. Ya. Svet (Baikov Inst. of Metallurgy, Academy of Sciences, SSSR). Doklady Akad. Nauk S.S.S.R., 140: 805-6(Oct. 1, 1961). (In Russian)

The determination of emissivity ("non-blackness") is difficult to obtain in measuring the true temperature by radiation. The temperature difference $\Delta T^{-1} = T_e^{-1} - T_{true}^{-1} = \Lambda \ln E/C_2$, where T_{true} is the true temperature, and T_e is the equivalent temperature determined by radiation (T_l for luminous radiation, T_{Br} for brightness radiation). The term Λ designates the effective wave length $[\Lambda = \lambda_1\lambda_2/(\lambda_2-\lambda_1)]$ for a luminous pyrometer. The term E designates the emissivity for the wavelength λ_{eff} for the brightness pyrometer, and for the bichromatic pyrometer $E = \epsilon_1/\epsilon_2$, where ϵ_1 and ϵ_2 are the spectral, emissivity coefficients at λ_1 and λ_2. The pyrometric constant $C_2 = 14380\ \mu$-deg. The desirability of decreasing ΔT by using radiation of shorter wavelength is attractive, since most metals have a resonance absorption (anomalous dispersion) in the near ultraviolet. Thus, the data for incandescent tungsten metal at 2500°C indicate that ΔT changes sign from +50 to −18°C for the spectral region of 0.280 to 0.345 μ because of a "resonance hump." The metals iron, nickel, and cobalt at 1500°C show a $\Delta T \cong 85$°C at $\lambda_{eff} = 0.45\ \mu$ compared to a $\Delta T \cong 150$°C at $\lambda_{eff} = 0.65\ \mu$. (TTT)

3104 THE INERT GAS PURIFIER. Kazimierz Grotowski, Henryk Rapacki, and Mieczysław Słapa (Inst. of Nuclear Physics, Kraków). Nukleonika, 6: 517-22 (1961). (In English)

A device used for purification of inert gases used in nuclear detectors such as grid ionization chambers, proportional, and gas scintillation counters is described. Gas to be purified circulates in a system containing a column consisting of trays with Ca and Mg shavings, horizontal pipes, valves, and a detector to be filled with a pure gas. The device is designed to work at up to 10 atm. The apparatus is out-gassed very carefully. It is filled with argon, which is circulated for 5 hours and then pumped out. Operation is based on the thermal circulation principle. The process depends on the filter temperature and purification time, which, in turn, are functions of the gas pressure and the chemical composition of the filter. The best resolution obtained for alpha particles from natural uranium at 4.20 and 4.76 Mev was 6%. Commercial argon at 6 atm was used. Curves obtained show that the filter temperature cannot be lower than 210°C and that the one containing calcium mixed with magnesium gives better results than that containing pure calcium only. (L.N.N.)

3105 SPACE-CHARGE NEUTRALIZED ION BEAMS. G. G. Kelley and O. B. Morgan (Oak Ridge National Lab., Tenn.). Phys. Fluids, 4: 1446-7(Nov. 1961).

In experiments with intense hydrogen ion beams (H_2^+ ions) it is found that these beams are automatically space-charge neutralized when focused by a magnetic solenoidal lens, unless an electron drain is provided. If electrons are drawn out by a positive bias, a spreading consistent with expected behavior of a beam with no neutralization is obtained. A localized transverse magnetic field near the target did not affect neutralization. (N.W.R.)

3106 SMALL-SIZED STRONTIUM-90 APPLICATOR. Karlheinz Renner and Hans J. Heinrichs (Strahlenklinik, Bonn). Röntgen Bl., 14: 315-20(Oct. 1961). (In German)

A description is offered of a small-sized strontium-90 applicator provided with a 0.196−cm^2 surface of radiation. The preparation support is constructed in such a manner that the source of radiation can be drawn out for the duration of application in a fully insulated manner. Thus, the source of radiation can be introduced deeply into narrow body cavities under adequate ray protection measures. Doses and ray protection measures are given. (auth)

3107 PROCEEDINGS OF THE NINTH CONFERENCE ON HOT LABORATORIES AND EQUIPMENT, CHICAGO, ILLINOIS, NOVEMBER 7-9, 1961. Paul R. Fields, ed. (American Nuclear Society, Chicago). 399p. $10.00(ASN)

Papers presented at the Ninth Conference on Hot Laboratories and Equipment are given. Separate abstracts were prepared for 49 of the papers. The remaining paper was previously abstracted for NSA. (M.C.G.)

3108 A NEW POSTIRRADIATION EXAMINATION LABORATORY AT THE OAK RIDGE NATIONAL LABORATORY. A. R. Olsen (Oak Ridge National Lab., Tenn.). p.3-14 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

A new postirradiation examination laboratory was constructed at the Oak Ridge National Laboratory. The facility will accommodate materials of extremely high-level alpha activity and kilocurie levels of gamma activity. Special provisions were included to facilitate the postirradiation examination of materials being investigated for advanced reactor applications. The building arrangement, cell construction, and special features, designed to permit operations with complete containment and with essentially no personnel entry, are described. The remote installation and removal of equipment, storage of contaminated equipment, remote decontamination, and remote maintenance features of the facility are expected to provide safer operation, increased cell utilization, and decreased operating costs. (auth)

3109 LIVERMORE ALPHA-GAMMA-NEUTRON CHEMISTRY CELL. M. S. Coops and C. L. Hanson (Univ. of California, Livermore). p.15-21 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961. (UCRL-6468-T)

A special-purpose cell was constructed for the processing of highly alpha-active, neutron-emitting isotopes. This

cell utilizes aqueous shielding, internally-mounted polar-type manipulators, and air-tight vinyl booting throughout the radioactivity processing enclosures. The active material is confined to readily-disposable, lightweight boxes inside the biological shielding. Transfer and storage facilities are provided for the safe and easy removal of highly alpha-active materials to other enclosures. (auth)

3110 A CHEMISTRY HOT CELL FOR HANDLING ALPHA–GAMMA ACTIVITIES. J. R. Berreth and R. P. Schuman (Phillips Petroleum Co., Idaho Falls, Idaho). p.22-6 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

A high density concrete shielded cell was built at the MTR for carrying out chemical separations of alpha and gamma emitting elements. All chemical operations are carried out with manipulators inside air-tight isolation boxes. Features of the cell and supporting equipment are described. (auth)

3111 TRANSURANIUM DEVELOPMENT FACILITY. B. B. Klima (Oak Ridge National Lab., Tenn.). p.27-34 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

An alpha-tight transuranium development facility was designed and is being installed in a cell with the immediate objective of studying the chemistry of the recovery of americium and curium from rare earths and fission products by ion exchange techniques. In addition, it is to provide a facility in which may be tested design concepts and equipment for use in a larger Transuranium Laboratory and Facility, now in the preliminary stages of design. (auth)

3112 RADIOACTIVE MATERIALS LABORATORY UNION CARBIDE NUCLEAR COMPANY. C. F. Vandenbulck (Union Carbide Nuclear Co., Tuxedo, N. Y.). p.35-43 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

The Radioactive Materials Laboratory (hot lab) at the nuclear research center of Union Carbide Corporation is described. Features of this facility include: transfer of radioactive material from the reactor pool directly to the hot cells via a canal; a large canal gamma facility utilizing spent fuel elements; an unique, inexpensive intercell conveyor; and an integrated plant for treating radioactive waste liquids. A 4,000 curie Co^{60} source, utilized for radiation chemistry studies, is in one cell. (auth)

3113 NASA PLUM BROOK REACTOR HOT LABORATORY FACILITY. Robert E. Oldrieve (Lewis Research Center Facilities, Sandusky, Ohio). p.44-55 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

A description is presented of the National Aeronautics and Space Administration's high level gamma hot laboratory building and of the hot cell equipment for examination and analysis of materials test specimens. The building houses 100,000 cubic feet of multikilocurie shielded volume including a 40 × 74 foot hot handling bay and seven hot cells. Emphasis was placed on the following: elimination of transfer casks for experiment test rigs, interchangeability of equipment within the hot cells, a "cold" operating area achieved by design and practice, large hot storage areas capable of handling complete test rigs, and electromechanical control of all equipment not readily operated by master-slave manipulators. (auth)

3114 THE EXPANDING ROLE OF CONTAINMENT ENCLOSURES. Nelson B. Garden. p.56-7 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

Containment enclosures and their uses are described. Standardization of methods and equipment is discussed. (M.C.G.)

3115 THE PLUTONIUM FUEL FABRICATION FACILITY AT ARGONNE NATIONAL LABORATORY. A. B. Shuck (Argonne National Lab., Ill.). p.58-63 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

A laboratory and pilot plant for the development of a variety of plutonium reactor fuel elements is described. This facility is housed in a building designed to control contamination hazards both within and outside the building. Processes and equipment are enclosed in gas-tight gloveboxes. Equipment is arranged departmentally, rather than in production lines, to achieve maximum process flexibility. Oxidation and fire hazards are controlled by use of a helium atmosphere. Fabrication process equipment is provided for fabrication of plutonium alloys by a variety of means, for jacketing and bonding, and for finishing and assembly operations on a wide variety of fuel elements. (auth)

3116 GLOVEBOXES FOR PLUTONIUM METALLURGY RESEARCH AT ARGONNE NATIONAL LABORATORY. L. R. Kelman, J. L. Armstrong, W. H. Livernash, and H. V. Rhude (Argonne National Lab., Ill.). p.64-70 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

Free standing gloveboxes with stringent requirements for tightness and flexibility were developed to enclose plutonium research equipment. Various styles of gloveboxes were made from aluminum extrusions welded into a framework. Safety glass windows, aluminum panels and service flanges are O-ring gasketed to the framework. The gloveboxes can be used individually or easily connected into a line. Articles are posted in and out through vinyl pouches. Rubber gloves are clamped on plastic glove ports which are gasketed to the windows. The gloveboxes are normally used with 0.1 to 0.2 scfm of nitrogen flowing through them, but other atmospheres may be used. (auth)

3117 THE PREVENTION AND CONTROL OF FIRES IN GLOVE BOXES CONTAINING PLUTONIUM. R. R. King (General Electric Co. Richland, Wash.). p.71-7 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

Numerous and varied fire hazards exist in glove boxes containing plutonium. They range from oils, solvents, and paper products to pyrophoric metals. The glove box itself (i.e., gloves, plastic bags, Plexiglas panels, exhaust filters) is vulnerable. A dry chemical type extinguisher discharged into the glove box through a quick-coupling will safely extinguish all but the metal and filter fire. Burning plutonium can be safely contained by smothering with MgO sand. No effective method has been devised to extinguish a filter fire but a wire mesh prefilter minimizes the hazard by acting as an oil mist eliminator and fire stop. (auth)

3118 FIBERGLASS REINFORCED PLASTIC GLOVEBOXES FOR PLUTONIUM ANALYTICAL RESEARCH. J. P. Hughes and A. G. Jastrab (Argonne National Lab., Ill.). p.78-86 of "Proceedings of the Ninth Conference on

Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

An economical fiberglass reinforced plastic glovebox was designed for use in an analytical plutonium laboratory to eliminate chemical corrosion, decrease decontamination time, and increase flexibility of operation. Materials of construction were tested for chemical, fire, and heat resistance and decontamination efficiency. Coupling of boxes into a train and sealing gasketed windows in position, giving a helium-tight enclosure, was made with Thiokol adhesives. Boxes constructed during development stages were used for periods up to two years. (auth)

3119 GAS-TIGHT CELL AND MAGNETIC REMOTE CONTROLLED MANIPULATOR. M. Desroche (Centre d'Etudes Nucleaires, Saclay, France) and G. Cherel. p.87-90 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

A gas-tight cell equipped with a remote controlled magnetic manipulator, and shielded by 8 in. of cast iron is described. The design seems economic, as compared with units of conventional construction. This type of cell is considered suitable for manipulations in inert atmospheres (argon, helium, and nitrogen). (auth)

3120 REMOTE METALLOGRAPHY IN THE METALLURGY DIVISION AT AERE. J. H. Evans and H. H. Venables (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.91-106 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

Remote metallography was carried out at AERE, Harwell by several techniques. The problems involved and how the use made of earlier experience helped in the design of the present metallography cells are discussed. (auth)

3121 EXTENDED REACH MANIPULATOR. C. E. Saunders (AMF Atomics, Greenwich, Conn.). p.107-10 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

A manipulator for general hot cell work that provides twice the stroke of present manipulators and three times the volume coverage is described. The development of this mechanism and the effects it will have on over-all hot cell design, both from an operational standpoint, as well as the engineering design of future cells are discussed. (auth)

3122 THE MOBOT MARK II REMOTE HANDLING SYSTEM. John W. Clark (Hughes Aircraft Co., Fullerton, Calif.). p.111-20 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

A mobile general-purpose handling system was built and operated. Intended primarily for use in regions completely inaccessible to personnel, the only communication between vehicle and operator is a three-conductor cable. The feasibility of such fully-remote systems was conclusively demonstrated. The machine described is a first step in the development of equipment for operation in all hostile environments. An outline of the general theory of design for such systems is presented. (auth)

3123 THE ANL MODEL 3 MASTER-SLAVE ELECTRIC MANIPULATOR— ITS DESIGN AND USE IN A CAVE. R. C. Goertz, R. A. Blomgren, J. H. Grimson, G. A. Forster, W. M. Thompson, and W. H. Kline. p.121-42 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

Four ANL Model 3 Master-Slave Electric Manipulators are operating in the Chemical Engineering Senior Cave, Argonne National Laboratory. These manipulators have a load capacity of 50 pounds for 15 minutes and 30 pounds continuously. Master and slave arms are connected only by electrical cables. The master and slave arm assemblies are mounted on bridge and rail systems. The slave support system, together with the seven master-slave motions of the manipulator, make it possible for the tongs to reach any point within the cave. The manipulators have performed well and demonstrate several advantages over mechanically connected master-slave manipulators. (auth)

3124 AN ELECTRONICALLY CONTROLLED SERVOMANIPULATOR. S. Barabaschi, S. Cammarata, C. Mancini, A. Pulacci, and F. Roncaglia (Comitato Nazionale per l'Energia Nucleare, Ispra, Italy). p.143-53 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

An electronic force-reflecting servomanipulator with a load capacity of 50 pounds was constructed for nuclear industrial applications. The slave arms are mounted on a remotely controlled trolley to perform as a general-purpose robot. The design features provide a high degree of handling dexterity and safe performance. However, a considerable effort is needed to increase the reliability, reduce the cost and improve the remote maintenance of the servomanipulator. (auth)

3125 TRANSISTORIZED SERVO SYSTEM FOR MASTER-SLAVE ELECTRIC MANIPULATORS. C. W. Potts, G. A. Forster, and R. H. Maschhoff (Argonne National Lab., Ill.). p.154-60 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

A transistorized, force-reflecting servo system was developed for 50 pound capacity master-slave electric manipulators. This system has several improvements over similarly-used vacuum tube systems. The system utilizes three phase synchro excitation in a 6 kc positional data system to reduce the number of leads in the cables. Demodulator-modulator circuits are used to get relatively noise-free performance. A fail-safe circuit is included to set the brakes on the slave drive unit if an electrical failure occurs. The operating time at full capacity is extended by automatically increasing the power to the fixed fields of the servo-motors only when required. The maximum amplifier output is 320 watts at 60 cycles. (auth)

3126 A TECHNIQUE FOR MAKING EXTREMELY FLEXIBLE ELECTRIC CABLES. R. C. Goertz, G. A. Forster, and J. H. Grimson (Argonne National Lab., Ill.). p.161-3 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

A technique was worked out for making multiconductor electric cables which are very flexible and limp compared to commercially available cables. Finely stranded electric conductors with PVC insulation were twisted together to form strands. These strands were, in turn, twisted together to form a rope-like strand assembly. This assembly was lubricated with talcum powder or grease and placed inside a loose-fitting neoprene cover by expanding the cover with either a vacuum or pressurized air. (auth)

3127 REPLICATION OF SURFACES FOR HOT-CELL APPLICATION. R. E. McDonald, B. W. McCollum, and G. A. Moore (Oak Ridge National Lab., Tenn.). p.166-72 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

In order to assist in the evaluation of the corrosion and erosion phenomena of specimens and components exposed to various media under in-pile service conditions, several modified and new techniques were developed to replicate surface topography. The shortcomings of the standard Fax-film process as applied to hot-cell usage are discussed and the modifications necessary to produce high quality replicas are described in detail. Another method involving centrifugal casting of room-temperature vulcanizing (RTV) silicone rubber for the preparation of replicas of internal surfaces of pipe and other reactor components is outlined. The static casting of RTV silicone rubber and the possibility of producing positive replicas by backcasting with epoxy resin is demonstrated. In all techniques, surface topography can be reproduced in sufficient detail for examination in the cold laboratory at magnifications of 50 to 1000. (auth)

3128 THE EXAMINATION OF HIGHLY ACTIVE SPECIMENS AND RIGS BY RADIOGRAPHY AT DOUNREAY. K. M. Swanson (United Kingdom Atomic Energy Authority, Dounreay, Caithness, Scotland). p.173-6 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961. Chicago, American Nuclear Society, 1961.

By using an x-ray source with a small focal spot and magnification technique and by choosing suitable film, successful radiographs can be made of short lengths of specimens of the highest gamma activity. The use of a rotating lead disc containing collimating slits allows this technique to be extended to long specimens. With the disc in operation the criterion for whether or not the gamma fogging will spoil the picture is the activity per unit length of the specimen, and not the total activity. (auth)

3129 SEMI-REMOTE CONTROL OF TWO-HIGH, FOUR-HIGH LABORATORY ROLLING MILLS. C. J. Pokorny and A. B. Shuck (Argonne National Lab., Ill.). p.177-87 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961. (ANL-FGF-269a)

The adaptation of laboratory rolling mills to semi-remote control is described. Two-high, four-high rolling mills were modified for inert atmosphere glovebox enclosure. Work tensioning pinch rolls, guides and push botton operated manipulators were applied to these mills. Work tensioning required feed-back speed control to compensate for back slip and forward extrusion of the work. Interchangeable plate and bar chucking equipment was designed for the manipulators to provide maximum flexibility of mill application. (auth)

3130 PROCEDURE FOR DISASSEMBLING AN URANIUM–BISMUTH LOOP IN THE BNL METALLURGY HOT CELL. J. G. Y. Chow, J. R. Hare, A. F. Nielsen, and F. P. Pallas (Brookhaven National Lab., Upton, N. Y.). p.188-94 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

A 19 ft long U-Bi liquid metal loop was disassembled in the BNL metallurgy hot cell without serious difficulties. Alpha activity, created by the formation of Po^{210} in irradiated Bi, did not spread, and containment and decontamination of this toxic isotope were relatively simple. The ease of controlling the alpha activity was due to the fact that the polonium was dissolved in the bismuth. (auth)

3131 NEW DECONTAMINATION CHAMBER. M. E. McMahan (General Electric Co., Richland, Wash.). p.195-200 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

The installation of the decontamination chamber in the Hanford Radiometallurgy Laboratory greatly reduced the radiation exposure, air-borne contamination, cleaning time, and increased the efficiency. This stainless steel chamber uses plant steam, water and decontamination solutions through two solenoid controlled spray nozzles. (auth)

3132 REPLACEABLE GASTIGHT UTILITY PLUG FOR A SHIELDED FACILITY. R. A. Blesch and R. B. Wehrle (Argonne National Lab., Ill.). p.201-5 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

A sealed electrical utility plug and replacement procedure was developed for a gastight alpha-gamma facility. Two rubber gaskets form a gastight annulus between the plug and the utility hole liner. Pressurized gas is supplied to this annulus. If a gasket leak should ever develop, the flow of leaking gas will prevent air from polluting the cave atmosphere. If a serious gasket leak develops or if a new electrical cable is needed, a two-stage transfer bag procedure is used to replace the seal assembly without polluting the cave atmosphere. (auth)

3133 THE METALLOGRAPHIC FACILITIES IN THE RADIOMETALLURGY LABORATORY AT HANFORD. W. J. Gruber and E. C. Watts (General Electric Co., Richland, Wash.). p.206-12 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961. (HW-SA-2226)

Metallographic facilities in the Radiometallurgy Laboratory include remotely operated grinder-polishers, vacuum cathodic etching, electro-chemical etching, and a remote metallograph for the examination of irradiated reactor fuels and structural materials. The remotized metallographic facilities are consolidated into one shielded enclosure. The expediting of sample processing is enhanced because all phases of metallographic preparation and photography are at one location. (auth)

3134 AN AUTOMATIC DATA PROCESSING SYSTEM FOR THE HOT LAB. John T. Conboy (General Electric Co., Pleasanton, Calif.). p.213-19 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

An automated mass data processing system was innovated at the Vallecitos Hot Lab to serve as an administrative control for source and special nuclear material accountability; area criticality control; sample location, identification, and description control for experimental purposes. Procedures for introducing, extracting and compiling data which are used to establish the operating parameters in the Radioactive Materials Laboratory are shown as well as advantages and disadvantages of an automated system. (auth)

3135 TECHNIQUE FOR HYDROSTATIC BURST TESTING OF IRRADIATED TUBING. C. L. Boyd and E. C. Watts (General Electric Co., Richland, Wash.). p.220-3 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

Equipment and techniques were developed for hydrostatic burst testing or irradiated reactor pressure tubing. Successful burst tests were conducted at pressures up to 20,000 psi using a special tube closure which effectively seals the tube during testing. This closure consists of a set of grips similar to tubing tensile testing grips with an internal sealing member similar to an automotive wheel cylinder cup. Modification of the closure sealing member permitted adaptation of the closure for burst testing at temperatures to 700°F and pressures to 12,000 psi. Data obtained from tests conducted on irradiated Zircaloy-2 reactor tubing provided valuable information concerning the effect of in-reactor operating conditions on the life expectancy of the tubing and aided in confirming future design criteria. (auth)

3136 EXPENDABLE ABRASIVE CUTOFF MACHINE. William B. Doe (Argonne National Lab., Ill.). p.224-6 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

An inexpensive abrasive cutoff machine for radioactive samples is being used which differs from conventional machines in that the cutoff wheel rotates at only 173 rpm. An enclosure for the wheel is unnecessary since coolant is not thrown off the wheel at this slow speed. A removable vise is used which can be brought up to a viewing window for accurate positioning of small or delicate samples. The water coolant and cuttings can be solidified with plaster of Paris for disposal as solid waste. Any required decontamination of the machine is relatively easy because of its small size and simplicity. (auth)

3137 A COMPARATOR FOR POST-IRRADIATION THERMAL CONDUCTIVITY MEASUREMENTS. B. S. Shabel and S. C. Smith (Knolls Atomic Power Lab., Schenectady, N. Y.). p.227-32 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

Equipment based on the Powell thermal comparator was built for the measurement of the thermal conductivity of irradiated materials. It operates on the principle that the cooling rate of a heated object brought into contact with a cooler sample will be proportional to the thermal conductivity of the sample. Tests at room temperature on samples of known conductivity showed a linear relationship between cooling rate and conductivity over the range from approximately 0.1 to 1.2 watts/cm/°C. The equipment was designed for remote handling using standard metallographic specimens. (auth)

3138 DESIGN AND OPERATION OF A 15,000 CUBIC FOOT HELIUM RECIRCULATING AND PURIFICATION SYSTEM. R. M. Mayfield and W. G. Tope (Argonne National Lab., Ill.). p.233-8 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

The ANL Plutonium Fuel Fabrication Facility Recirculating and Purification System is described. The helium atmosphere is continuously recirculated at low pressure by a seven-stage turboblower. Purification is accomplished by passing compressed gas through a Molecular Sieve drying tower to remove moisture and an activated carbon tower to remove oxygen and other impurities. A parallel arrangement permits continuous operation and regeneration of either tower as required. The helium atmosphere is supplied to the gloveboxes with impurity levels below 3,000 ppm (0.3%) nitrogen, 1,000 ppm (0.1%) oxygen, and 100 ppm water. (auth)

3139 PRECISION REMOTE PLOTTING OF RADIATION DOSE DISTRIBUTIONS. F. X. Rizzo, H. Huszagh, P. Fallon, and A. Quadrado (Brookhaven National Lab., Upton, N. Y.). p.239-43 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

Instrumentation was developed utilizing an x-y-z positioner and an x-y recorder to perform precision remote plotting of radiation dose rate distributions in three dimensional targets. Accurate position measurements were made possible through careful synchronization of the coordinate axes of the recorder and the x-y-z positioner. The positioner was mounted over a water tank 12 feet × 8 feet × 6 feet deep. The over-all accuracy of the positioner is ±1/32" in any direction. The dosimetry system, which was mounted on the z-coordinate, was designed for rapid interchange of scintillation and ionization chamber dosimeters. (auth)

3140 PNEUMATICALLY PLACED CONCRETE SHIELDING. R. W. Dascenzo (General Electric Co., Richland, Wash.). p.244-52 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961. (HW-70527)

A method of placement of high density concrete is described. Pneumatically applied mortar has lower costs than conventionally placed high density concrete shields if it is applied correctly. However, close control of the operation is required to obtain specified density and compressive strength but greater density and strength can be obtained than by conventionally placed concrete with aggregates of the same specific gravity. The concrete is placed faster and has fewer voids than in normal placement. (auth)

3141 A HIGH INTENSITY RADIATION DEVELOPMENT LABORATORY AT BROOKHAVEN NATIONAL LABORATORY. Otto A. Kuhl (Brookhaven National Lab., Upton, N. Y.). p.253-8 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961. (BNL-5614)

A High Intensity Radiation Development Laboratory is being constructed at Brookhaven National Laboratory. This facility will house offices, laboratories, and a hot cell and canal complex. The cell complex, designed to remotely handle 1,000,000 curies of Co^{60}, comprises a work preparation cell, an experimental irradiation cell, and a connecting canal with two bays. The work preparation cell with its associated special equipment will provide the means for decanning, sorting, encapsulating, testing, and assembling sources for use in the experimental irradiation cell. The experimental irradiation cell is basically designed to perform large-scale batch and continuous irradiations. A conveyor system will provide for moving material in and out of the cell and properly passing it through various irradiation systems. (auth)

3142 MACHINES DEVELOPED FOR USE IN THE HIGH INTENSITY RADIATION DEVELOPMENT LABORATORY. D. W. Huszagh and G. Nugent (Brookhaven National Lab., Upton, N. Y.). p. 259-63 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

The special purpose machines used for preparing Co^{60} sources for service in the High Intensity Radiation Development Laboratory are described. These machines include a

railway system, a remotely operated pipe cutter, a source monitor, a source encapsulator, a capsule leak detector, and a source extractor. The railway system is used for transporting materials and equipment into and between the hot cells. The remaining machines are used in sequence for the encapsulation of Co^{60} sources into stainless steel sheaths. This is undertaken to prevent surface contamination in the later use of the sources. (auth)

3143 THE POST-IRRADIATION EXAMINATION FACILITIES AT WINDSCALE WORKS, U.K.A.E.A. V. W. Eldred and K. Saddington (United Kingdom Atomic Energy Authority, Sellafield, Eng.). p.264-88 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

The facilities provided and the techniques developed over a number of years at Windscale are described. These consist primarily of a pilot-scale fuel examination and breakdown cave capable of handling 1000 elements per year, together with the associated metallographic lines for the examination of the fuel and can specimens cut from the fuel elements. The experience gained in the operation of these facilities is described in relation to its influence on the design philosophy underlying the construction of the full-scale cave and line facilities nearing operation for the examination of up to 3000 standard and experimental fuel elements per year arising from the United Kingdom Civil Power Program. (auth)

3144 FEATURES OF THE SANDIA ENGINEERING REACTOR FACILITY IRRADIATION CELL. John L. Colp (Sandia Corp., Albuquerque, N. Mex.). p. 289-94 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

The heart of the Sandia Engineering Reactor Facility is a $22 \times 30 \times 9$ foot irradiation cell containing an unshielded 5-megawatt reactor. This irradiation cell was designed for the utmost flexibility for experimental usage. Some of the unique features are imbedded floor tracks and a remotely operated tug for inserting experiments; serpentine instrumentation ducts through the ceiling; underfloor ducts to provide controlled temperatures for experiments; a movable thermal column; an in-cell cryostat; and a specially designed periscope. (auth)

3145 STEAM CLEANING SYSTEM LIQUID METAL COOLED FUEL ELEMENTS. Harold L. Brinkman and Wendell Wilson (American Machine and Foundry Co., Greenwich, Conn.). p.295-306 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

A reactor service facility at the Enrico Fermi Atomic Power Plant performs the functions of receiving, inspection, and storage of replacement components for the reactor core, transferring these components to and from the reactor, and preparation of irradiated components for disposal. The system that is described has the prime responsibility of cleaning irradiated fuel elements in order to effect a transition from sodium to water cooling. In addition, this system transfers replacement components from storage to a sodium-filled tank for transport to the reactor. The mechanisms and associated process system are located in several biologically shielded areas and are remotely controlled from a central console. (auth)

3146 LABORATORY FOR PLUTONIUM FUEL ELEMENT FABRICATION AT CADARACHE. Y. Duvaux, R. Mas, A. Junca, and H. Dick (Commissariat a l'Energie Atomique, [Paris]). p.307-14 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

The first hot laboratory that is going to be operating at the new Nuclear Research Center of Cadarache is described. This is the Laboratory for Plutonium Fuel Element Fabrication mainly designed for the fabrication of the plutonium fuel elements for the Rapsodie reactor. The general design of the building, with its emergency approaches in case of accident, and the safety systems by telealarm in case of incident or accident, are emphasized. (auth)

3147 DECANNING OF IRRADIATED FUEL ELEMENTS AT MARCOULE (PRESENTED AS A MOVIE). C. Oger (Saint-Gobain Nucleaire, Courbevoie, France). p.315-16 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

The mechanical decanning facility is described which covers the total cycle of operations beginning with the discharge of the fuel elements from the reactors and ending with bare elements ready to enter the chemical processing plant. Each of the 6 steps are discussed. (M.C.G.)

3148 RADIOACTIVE WASTE HANDLING AT THE HANFORD LABORATORIES RADIOMETALLURGY FACILITY. C. G. McCormack (General Electric Co., Richland, Wash.). p.317-20 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961. (HW-SA-2228)

Radioactive wastes from the radiometallurgy facility are classified according to physical state and radiation level. A special method for handling each classification was devised. Volume measurements were made for each, and cost studies where possible. Two special waste handling casks are used. Intermediate level in-cell wastes are sealed with 20% gelatin for burial. All solid wastes are buried; liquid wastes are filtered and cribbed. Cells are exhausted to the atmosphere through absolute and charcoal filters. (auth)

3149 SANDIA PULSED REACTOR FACILITY BUILDING DESIGN AND CONSTRUCTION DETAILS. Roland G. Struss (Sandia Corp., Albuquerque, N. Mex.). p.321-3 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

This facility consists primarily of a prompt critical reactor providing an intense radiation source of short duration. The reactor is operated in a hemispherical concrete building with 54 inch thick shielding walls. Radiation streaming through the access door of this building is captured by a beam catcher building. An instrument building is located adjacent to the reactor building. The reactor is operated on a hydraulic elevator which permits it to be lowered and shielded after an operation. The reactor controls are operated from the control and operations building, which also has lab and office space. Experiments are set up in the reactor building with instrumentation being located outside of the building. (auth)

3150 PERSONNEL ACCESS TO ALPHA–GAMMA CAVES USING PLASTIC SUITS AND ENCLOSURES. Roland A. Blomgren (Argonne National Lab., Ill.). p.324-30 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

A nylon-reinforced vinyl "step-in" tunnel suit was designed for personnel protection during the repair and replacement of equipment in radioactively contaminated

areas. The low crotch of the suit enables an operator to step in or out when the tunnel is retracted. This ease of entry makes short term work possible and thus reduces the gamma dosage to the operator. Four cables inside the tunnel are fastened to the back of the suit and tensioned to counteract the differential air pressure due to the reduced pressure in the cave. These cables also pull the suit against the front of the operator's body to keep it out of his way. (auth)

3151 NEW FROGMAN TECHNIQUE. L. Csiba (Institut für Reaktorserkstoffe der Kernforschungsanlage, Jülich, Ger.). p.331-8 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

A new frogman technique was developed for working in rooms contaminated by alpha emitters or other dangerously radioactive materials. This technique avoids the extensive cleaning of the frogman and his suit after finishing the work. Cold areas are not contaminated by the frogman when leaving the hot rooms. (auth)

3152 ALPHA-GAMMA TRANSFER SYSTEMS. Mahlon Wilson and Linas Thorn (Los Alamos Scientific Lab., N. Mex.). p.344-50 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

Two transfer systems that provide mechanical sealing of metal containers were developed for handling alpha-beta-gamma emitters. These systems increase the versatility of the cells and reduce the problems normally associated with plastic bagging techniques. The containers are used for routine transfers and for storage of material or equipment. (auth)

3153 NEUTRON SHIELDING CALCULATIONS FOR CURRENT WINDOW DESIGNS. F. C. Hardtke (Argonne National Lab., Ill.). p.351-62 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

Several 49-inch thick window designs were compared to heavy concrete in their neutron and gamma shielding effectiveness. Computations for two common designs, glass-$ZnBr_2$ and glass-oil, give biological dose rates for fission neutron sources within an order of magnitude higher than that of magnetite concrete. Slightly better neutron shielding was afforded by the glass-oil design, which also is better suited for the thermal neutron and gamma flux reduction resulting from the addition of boron to the window. Both designs maintain an adequately high average density for satisfactory gamma ray attenuation. One problem, not yet fully evaluated, is the neutron activation of bromine in the glass-$ZnBr_2$ design. (auth)

3154 ZINC BROMIDE WINDOWS FOR NEUTRON AND GAMMA RAY SHIELDING. C. H. Youngquist (Argonne National Lab., Ill.) and L. M. Rentschler. p.363-75 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

The new chemistry cave complex at Argonne National Laboratory will have a total of forty zinc bromide windows. The window tanks will be of cast malleable iron built into the cells as an integral part of the concrete walls. A fission source of 10^{12} neutrons per second and a 10^6 curie 1 Mev gamma source govern the shielding requirements. Zinc bromide windows meet these needs and suffer least from radiation exposure effects. Where gamma activity is a maximum, composite windows are used with a slab of 3.3 density glass attenuating the gamma rays to the point where they are tolerable to the zinc bromide solution. (auth)

3155 A NEW APPROACH TO THE PROBLEM OF CLOUDY RADIATION SHIELDING WINDOWS. J. S. Mazza and T. E. McGary (Pittsburgh Plate Glass Co., Harmar Township, Penna.). p.376-82 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

The radiation induced clouding of oil in shielding windows is caused mainly by oxidation of the oil as shown by the presence of peroxides and acids in irradiated oil samples. These oxidation products attack the metallic lead present in the window to form lead salts which later separate as a cloudy sludge. Tricresylphosphate plasticizer used in Koroseal 116 gasket leaches into the oil and intensifies this reaction. A gasket containing a different plasticizer has eliminated this intensified reaction. Elimination of air spaces within the shielding window and the use of degassed oil will aid in minimizing the oxidation and subsequent clouding of windows. (auth)

3156 GASTIGHT SEAL AND INSTALLATION TECHNIQUE FOR A KILOCURIE GAMMA SHIELDING WINDOW. K. R. Ferguson, D. E. Czernik, and L. M. Safranski (Argonne National Lab., Ill.). p.383-7 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961.

A shielding window was designed for use in a sealed kilocurie research cave containing a high-purity atmosphere. The window opening is sealed independently by both the window and the gas seal plate. The gas seals are formed by neoprene gaskets which retain sufficient resilience after a gamma exposure of 10^7 r. The space between the window and the gas seal plate is pressurized with the same type of gas as that within the cave. Hence, a little leakage does not effect the purity of the cave atmosphere. Repairs can be made on either the window or the gas seal plate without large effects on the cave atmosphere. The window and its auxiliary parts are installed after heavy cave construction has been completed. Special low strength mortar is used for shielding between the window and liner to facilitate the removal of the window. (auth)

3157 IMPROVEMENTS IN ION SOURCES. Siegfried Klein (to Commissariat a l'Energie Atomique). British Patent 882,366. Nov. 15, 1961.

An ion source for ionizing gases or vapors to form an accelerator feed is designed for high ionic yields on the order of 10 ma for a h-f power of 75 watts. The ion source comprises an evacuated tube with a high direct potential difference between its ends and is housed in a coaxial resonating cavity which is coupled to a h-f current source in such a way that a restricted zone of very intense h-f field is formed in one end of the tube. Gas is fed into the other end of the tube and thence to the h-f field where it is ionized. (D.L.C.)

3158 IMPROVEMENTS IN ION SOURCES, AND IN PARTICULAR IN THE ION EXTRACTING MEANS THEREOF. Siegfried Klein (to Commissariat a l'Energie Atomique). British Patent 882,367. Nov. 15, 1961.

An ion source of the type described in British Patent 882,366 (using a resonating cavity to create a restricted zone of intense h-f field for ionization purposes) is designed with an extraction electrode and an accelerating and collecting electrode, the latter passing only the central portion of the extracted ion beam. (D.L.C.)

3159 IMPROVEMENTS IN OR RELATING TO SAFETY DEVICES. Vsevolod Dochkevitch (to Commissariat a l'Energie Atomique). British Patent 882,402. Nov. 15, 1961.

A safety device is described which may be fitted to appliances performing successive and programmed operations, e.g., an automatic handling machine. The device comprises a framework containing a cursor or guided nut moved in synchronism with the drive means of the appliance and a movable abutment holder holding one or more abutments arranged as a function of the operations being supervised. If one operation is forgotten or performed incorrectly, the corresponding abutment stops the cursor and thus the appliance. Thus, the device forms an analog unit in which the cursor position represents the cycle state of the appliance. (D.L.C.)

3160 IMPROVEMENTS IN OR RELATING TO RADIATION THICKNESS GAUGES. George Syke and William Thomas James (to Baldwin Instrument Co., Ltd.). British Patent 882,729. Nov. 15, 1961.

A radiation thickness gage using a backscatter technique is designed for measuring the thickness of a film being passed between two cylinders. The gage comprises a radiation source and an ionization chamber pivotally mounted so that both can swing together between the operative position viewing a film-covered cylinder and a standardizing position viewing a bare cylinder. The geometrical relationship of the measuring head to the film during measurement is kept the same as that of the head to the bare cylinder during standardization. (D.L.C.)

3161 DOOR HINGING DEVICE WHICH MAKES IT POSSIBLE TO MOVE HEAVY DOORS WITH A REDUCED EFFORT. Raymond Haguet (to Commissariat a l'Energie Atomique). British Patent 883,281. Nov. 29, 1961.

A hinge assembly is designed whereby heavy doors weighing up to several tons may be opened and closed with a manual force of a few kg. The assembly comprises hinges with opposed load-bearing surfaces arranged transversely to the axis of the hinges and means for supplying oil under pressure between the surfaces to form a lubricating layer. The oil pressure circuit may also be arranged to lock or unlock the door, e.g., by means of hydraulic jacks acting on locking bolts. (D.L.C.)

3162 IMPROVEMENTS IN OR RELATING TO LIFTING AND LOWERING GEAR. Laurence Hack and John Oliver Cowburn (to United Kingdom Atomic Energy Authority). British Patent 883,318. Nov. 29, 1961.

Gear suitable for lifting and lowering control rods out of and into vertical channels in a reactor core comprises a pancake winding drum and a flexible winding cable consisting of a length of flattened tubular woven stainless steel wire braid. (D.L.C.)

3163 IMPROVEMENTS IN AND RELATING TO STRUCTURE SUPPORTING LINKWORK ASSEMBLIES. Douglas Frank Seymour and John Walton (to English Electric Co.). British Patent 883,414. Nov. 29, 1961.

A linkwork assembly is designed for applying external support to a reactor moderator structure. The assembly comprises a plurality of link members arranged end-to-end in a ring around the structure and means for coupling the link members to support plates bearing on the structure surface. The coupling means is constructed so that, in event of failure of any one of the link members, the supporting effect is retained. (D.L.C.)

3164 IMPROVEMENTS IN OR RELATING TO CASTING APPARATUS. John Mortimer, Robert Carlton Kenyon, and James Henry Tonkin (to United Kingdom Atomic Energy Authority). British Patent 883,698. Dec. 6, 1961.

An improved casting apparatus is designed for the encapsulation of a radioactive salt, e.g., cesium sulfate for teletherapeutic use. In operation of the apparatus, a radioactive salt solution is evaporated to dryness and then fused in a vessel, the vessel is tilted to pour the fused salt into a capsule, and indication that a pre-determined amount of salt was poured into the capsule is given by a balance arm arrangement. (D.L.C.)

3165 AUTOMATIC MASS SPECTROMETER. M. L. Hanson and C. D. Tabor, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,012,139. Dec. 5, 1961.

A mass spectrometer for analyzing the components of a gas is designed which is capable of continuous automatic operation such as analysis of samples of process gas from a continuous production system where the gas content may be changing. (AEC)

3166 GRIPPING TOOL. R. J. Sandrock (to U. S. Atomic Energy Commission). U. S. Patent 3,012,811. Dec. 12, 1961.

A self-actuated gripping tool is described for transferring fuel elements and the like into reactors and other inaccessible locations. The tool will grasp or release the load only when properly positioned for this purpose. In addition, the load cannot be released except when unsupported by the tool, so that jarring or contact will not bring about accidental release of the load. The gripping members or jaws of the device are cam-actuated by an axially slidable shaft which has two lockable positions. A spring urges the shaft into one position and a solenoid is provided to overcome the spring and move it into the other position. The weight of the tool operates a sleeve to lock the shaft in its existing position. Only when the cable supporting the tool is slack is the device capable of being actuated either to grasp or release its load. (AEC)

Heat Transfer and Fluid Flow

3167 (ANL-6436) AN ANALYSIS OF SPECIFIC HEAT DATA FOR WATER AND WATER VAPOR IN THE CRITICAL REGION. Technical Report No. 8. E. S. Nowak and R. J. Grosh (Purdue Research Foundation, Lafayette, Ind.). Oct. 1961. For Argonne National Lab., Ill. Contracts AT(11-1)-1026 and W-31-109-eng-38, Subcontract 31-109-38-704. 80p.

A comprehensive review of the available data for the specific heat at constant pressure of water and water vapor is given for pressures from 14.22 to 4300 psia and temperatures from 680 to 800°F. In addition a description is given of the various experimental techniques employed by different investigators to carry out measurements of this property. Deviations of up to 20% are shown to be in existence between the measured values of specific heat of different investigators. The estimated apparent over-all error in the specific heat measurements was found always to be within 5%. In view of the actual deviation it would appear that the various estimates that were made on the apparent over-all error are somewhat optimistic. An attempt was made to show that excessive random and systematic errors may arise in the critical region when values obtained from mean specific heat measurements are considered as being identical to the instantaneous values of specific heat. There are no specific heat formulations $C_p = C_p$ (P, T), in existence for the part of the critical region where the specific heat first increases with temperature, attains a maxi-

mum finite value, and then subsequently decreases with temperature. Consequently, the smoothed values of the specific heat at constant pressure of various steam tables were derived by graphical interpolation of different experimental data. Deviations between the various smoothed data for the specific heat at constant pressure approach and even exceed 30%. This is especially true in the regions of maxima of various isobars. These large deviations are due, in part, to the error introduced by graphical interpolation and also to the previously mentioned deviations among the experimental data. The specific heat was derived in the critical region from P-V-T data. The deviations between the derived and measured values were generally between 10 to 20%. Near the critical point, at supercritical pressures, and in the region of maximum specific heats along various isobars, the deviations were larger. However, except for one point, even these deviations were entirely within 40%. Finally it is shown that the pressure and temperature relation corresponding to the maximum values of specific heat along isobars is different to that corresponding to specific heat along isotherms. This is significant insofar as it was previously thought by other investigators that the locus of points on a pressure temperature diagram defining $(\partial C_p/\partial P)_T = 0$ was identical to the locus of points defining $(\partial C_p/\partial T)_P = 0$. The physical significance of the region enclosed by the locus of points on a pressure temperature diagram defining $(\partial C_p/\partial T)_P = 0$ and $(\partial C_p/\partial P)_T = 0$ is not known. It is possible that the region enclosed by the above two curves is the boundary between the liquid and vapor phases in the supercritical region. (auth)

3168 (HW-69882) DR-1 GAS LOOP THERMAL AND FLUID FLOW ANALYSES. R. E. Baars (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 16, 1961. Contract AT-(45-1)-1350. 52p.

Computer (IBM-7090) programs were developed for calculating the pressure drop and temperature distribution in the DR-1 Gas Loop, an in-reactor test facility for irradiation of fuel elements and materials for gas-cooled reactors. The underlying fluid flow and heat transfer analyses are reported. The coolant may be helium, nitrogen, or carbon dioxide. (D.L.C.)

3169 (SAN-1001) TEMPERATURE VARIATION, HEAT TRANSFER, AND VOID VOLUME DEVELOPMENT IN THE TRANSIENT ATMOSPHERIC BOILING WATER. H. A. Johnson, V. E. Schrock, F. B. Selph, J. H. Lienhard, and Z. R. Rosztodzy (California. Univ., Berkeley. Inst. of Engineering Research). Jan. 1961. Contract AT(11-1)-34. 227p.

Experimental determinations of surface temperature, and the volume of vapor produced are given for the atmospheric pool boiling of water on metallic ribbons in which energy is uniformly generated at an exponentially increasing rate in time. The subcooling of the pool was varied between 2 and 112°F and the period of the transient pulse ranges between 5 and 80 milliseconds. These conditions are typical of those in a nuclear reactor experiencing a prompt-critical excursion. The effects of thermal capacity of the ribbon and orientation of the heating surface were also studied. These results exhibited decided trends although, since the system was extremely sensitive to minor random variations, they were reproducible only within limits that were necessarily broad. No general correlations were formed, but a method for predicting the rate of vapor volume development was devised and applied with some success in the case of saturated transient boiling. The effects of pressure and velocity are presently being studied. (auth)

3170 (TID-13485) HEAT TRANSFER AND PRESSURE DROP FOR A GAS AT HIGH TEMPERATURE. Monty E. Davenport, Patrick M. Magee, and George Leppert (Stanford Univ., Calif. Nuclear Technology Lab.). May 1961. Contract AT(04-3)-247. 62p. (SU-247-2).

Local convective heat transfer coefficients and local and average friction factors were measured for N flowing through and electrically heated, smooth, round tubes. Data are reported for a range of Reynolds numbers from 1800 to 90,000, surface temperatures to 1455°F, gas temperatures to 780°F, and heat fluxes to 138,000 Btu/(hr)(sq ft). Results are graphically summarized. (J.R.D.)

3171 (UCRL-13016) THE EFFECTS OF RESONANT VIBRATIONS ON HEAT TRANSFER AT HIGH REYNOLDS NUMBERS. Final Report, June 13, 1961–August 13, 1961. Thomas W. Jackson, Calvin C. Oliver, and Ian Eastwood (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). For Univ. of California. Lawrence Radiation Lab., Livermore. Contract [W-7405-Eng-48]. 58p.

Results are presented for a series of experiments conducted for the purpose of studying the local and over-all effects of a resonant acoustic vibration on the heat transfer coefficient for air flowing through a constant temperature isothermal tube in the turbulent Reynolds number range, 16,000 to 200,000. The local heat transfer coefficient is shown to vary periodically between the nodes and loops of the resonant sound wave. It was noted that at Reynolds numbers below approximately 35,000 the maximum local Nusselt numbers occur at the velocity loops. Above 35,000 the maximum values of the Nusselt number shifted to the velocity nodes. The reason for this shift was not apparent. Tables of data are included for possible analytical investigations. Data are reported for two resonant frequencies 1500 cps and 222 cps and for sound pressure levels to 164.5 decibels. At 1500 cps the highest sound pressure level that could be obtained was 147.3 decibels. (auth)

3172 (UCRL-Trans-739) CHARACTERISTICS OF FLUIDIZED PARTICLES. II. EXPANSION OF FLUIDIZED PARTICLES BY A GAS STREAM. Junji Furukawa and Kyo Omae. Translated for Univ. of California Lawrence Radiation Lab., Berkeley from Kogyo Kagaku Zasshi, 55: 3-6 (1952). 11p.

Proposals are given for the expansion of a stream of fluidized spherical vinyl acetate polymer particles. When the expansion ratio, V/V_0, where V is the apparent volume of the fluidized particles moving in a gas stream of velocity U, and V_0 is the volume of the fluidized particles at rest, is small, there is a linear relation between V/V_0 and U. At higher velocities of the gas stream, V/V_0 increases faster than U. A comparison is made of experimental and calculated values of V/V_0 for particle average diameters from 0.277 to 0.755 mm. (B.O.G.)

3173 CHARACTERISTICS AND APPLICATIONS OF PLATE HEAT EXCHANGERS. Luciano Galli and Giuseppe Farina (Societa "Alfa Laval," Milan). Chim., e ind. (Milan), 43: 1135-42 (Oct. 1961). (In Italian)

With reference to the origin of plate heat exchangers, the principles of their apparatus, their design characteristics, and applications are discussed. Particular reference is made to plate exchangers compared to the conventional shell-and-tube exchangers. Plate exchangers are superior in efficiency, easy maintenance, versatility, lower weight, and smaller dimensions. For the above characteristics, plate exchangers are a modern and efficient plant unit in a number of chemical processes. (auth)

3174 THERMAL STRESSES IN TUBE PLATES. C. de Pater. Ingenieur, (Utrecht), 73: No. 35, W123-7(1961).

The steady-state stress analysis for steam generators for reactors is described. Methods are given to calculate these thermal stresses in tube plates. A number of formulas are derived to calculate the free and discontinuity steady-state thermal stresses in heavy tube sheets. (NPO)

3175 SIMPLIFIED CALCULATION ON THERMAL TRANSIENT OF A UO_2 FUEL ROD. L. S. Tong (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng., 11: 340-3(Nov. 1961).

A lumped parameter technique is described for simplifying the calculation of a thermal transient of a uranium dioxide fuel rod. The calculation is accomplished by evaluating the thermal resistances and capacitances of the pellet and the clad at their average conditions in time and space. Each quantity is lumped at the middle of its physical geometry and axial heat conduction is neglected. The equivalent thermal circuit is shown. The technique gives a fairly accurate solution in comparison with other exact methods. (N.W.R.)

3176 FLOWING OF THE CONDUCTIVE GAS IN THE MAGNETIC GASODYNAMICAL GENERATOR. O. A. Berezin. Vestnik Leningrad. Univ., 16: No. 13, Ser. Mat. Mekh. i Astron. No. 3, 93-102(1961). (In Russian)

Two-dimensional stationary flow of conductive gas in the case in which the normal component of the vector of magnetic induction is determined by $B_z = B_0 \sin(\pi/a)x \, ch(\pi/a)z$ $(0 < x < a)$. The problem is solved by the method of the "small parameter" for which the value of $\delta = 4\pi\mu\sigma$ is taken. The laws of changing of hydrodynamic and magnetic values inside the space between poles are found, and the electromotive force for the case of supersonic velocities is calculated. (auth)

3177 APPARATUS FOR MICROSCOPIC EXAMINATION. (to C. Reichert Optische Werke Aktiengesellschaft). British Patent 880,708. Oct. 25, 1961.

A remotely controlled apparatus is designed for the microscopic examination of radioactive specimens. The apparatus comprises a microscope, an illuminating device, a viewing device, an objective changing device and control elements for operating the microscope. The microscope is mounted in a shielding chamber, but the illuminating and viewing devices are outside the chamber with two lens systems arranged to project the light onto the specimen and to project an image of the specimen onto the viewing device. (D.L.C.)

Instrumentation

Refer also to abstracts 2857, 2862, 3013, 3273, 3841, and 3960

3178 (AERE-M-905) THE USE OF SILICON CONTROLLED RECTIFIERS FOR REACTOR EXPERIMENTAL-RIG FURNACE CONTROL. J. E. Partridge (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Aug. 1961. 7p.

A method of controlling small furnaces is described, such as is suitable for use in reactor experimental rigs. A prime consideration was compactness of the equipment. A typical circuit is detailed. (auth)

3179 (ANL-6448) ESTIMATING THE PERFORMANCE OF NEUTRON TIME-OF-FLIGHT SPECTROMETERS. George S. Stanford (Argonne National Lab., Ill.). Nov. 1961. Contract W-31-109-Eng-38. 13p.

Analogy with optical instruments is used to develop formulas for estimating the counting rate achieved by a neutron time-of-flight system. Input data consist of the flux at the spectrometer entrance and some of the physical characteristics of the spectrometer. Convenient relations for the comparison of different systems are presented. (auth)

3180 (ANL-6449) THE PRELIMINARY CHOICE OF DESIGN PARAMETERS FOR NEUTRON CHOPPERS. George S. Stanford (Argonne National Lab., Ill.). Nov. 1961. Contract W-31-109-eng-38. 18p.

Some of the factors affecting the counting rate achieved by a neutron chopper spectrometer are investigated. It is shown that in a chopper of optimum design the counting rate per channel at any given energy is proportional both to the slit width and to the square of the resolution in μsec/m, as well as to the cutoff velocity v_c of the rotor; this last is because a larger number of bursts per second become possible as v_c is increased. For an idealized cutoff function, it is shown that the total running time for measuring a spectrum is minimum when the ratio of cutoff velocity to peripheral velocity of the rotor is such that approximately 1.67 runs per energy decade are required; this means that the chopper speed and the time-channel width are changed by a factor of two from one run to the next. (auth)

3181 (NDL-TR-9) THE EFFECT OF BORON-10 SHIELDS ON THE CALIBRATION OF NEUTRON-THRESHOLD DETECTORS. John H. McNeilly and John W. Kinch (Army Chemical Corps Nuclear Defense Lab., Army Chemical Center, Md.). Aug. 1961. 22p.

The results of an experiment designed to study the effect of B^{10} shields on the neutron flux and spectrum as measured by threshold detectors are described. The results include comparison of data obtained from threshold detectors exposed to a neutron field in the following environments: in steel spheres whose periphery is filled with B^{10}, in pressed and sintered B^{10} spheres, in cadmium capsules, and unshielded. It was found that there was no significant difference between results obtained from threshold detectors exposed in the pressed and sintered B^{10} spheres and the results obtained from threshold detectors exposed in steel spheres with B^{10} filled peripheries. The cadmium spacers which separate the threshold detectors from each other in the B^{10} sphere had no significant effect on the measured neutron flux and spectrum. There was a real effect of the B^{10} sphere on the neutron flux and spectrum as measured by the threshold detectors within the sphere. A 30% attenuation factor was observed for the sulfur threshold detector. A quantitative attenuation factor was not obtained for Np^{237} and U^{238} because of the poor reproducibility of the data. The calibration of an automated counting system contained within a mobile laboratory is included. (auth)

3182 (NDL-TR-11) METHOD OF EVALUATION OF EXPERIMENTAL RADIATION MEASUREMENTS OVER A RECTANGULAR SOURCE. John L. Meredith (Army Chemical Corps Nuclear Defense Lab., Army Chemical Center, Md.). Apr. 1961. 25p.

A method of data analysis was derived for the evaluation of radiac instrument measurements over a rectangular test area which takes into consideration the size and shape of the test area, the location of the instrument, the distribution of the contaminant, and the instrument error. (auth)

3183 (ORINS-40) A HIGH MAGNETIC FIELD BUBBLE CHAMBER. Report of ORINS-ORNL Study

Committee. (Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.). [1960]. Contract [AT(40-1)-Gen-33]. 60p.

Topics covered on the high-field bubble chamber concept include the following: some idea of the physics that can be carried out with such a device; sources of high fields with particular attention being given to superconducting magnets; some of the design problems associated with operation in a cryogenic environment; and a technique for optimizing the chamber-size field-intensity parameters. Recommendations concerning future action to be taken in the program are also given. (N.W.R.)

3184 (SCR-430) THE EFFECT OF RAIN CLOUDS ON THE DESIGN OF RADAR ALTIMETERS. C. H. Bidwell (Sandia Corp., Albuquerque, N. Mex.). Oct. 1961. 22p. Contract [AT(29-1)-789].

An analysis is presented of all the factors determining the susceptibility of aircraft-borne radar altimeters to false indication of height due to rain clouds. Data are presented on rains of various densities, and the application of the results to the operation of radar altimeters is considered. (D.L.C.)

3185 (UCRL-6298) FAST TRANSIENT HIGH-INTENSITY GAMMA-RAY SOLID STATE DETECTORS. William F. Lindsay (California. Univ., Livermore. Lawrence Radiation Lab.). May 1961. Contract W-7405-eng-48. 55p.

Feasibility studies were conducted to provide criteria for the development of reverse-biased p-n junction solid state devices as current detectors of high intensity fast transient gamma flux radiation. The sensitivity of silicon in which a p-n junction exists is calculated to be $S \simeq 5 \times 10^{-19}$ amperes per cm^2 of junction area per micron of depletion layer width per γ-Mev/cm^2 sec for 1- to 3-Mev gamma rays. Device sensitivity variations as a function of variable incident gamma flux pulse widths is calculated. Experimental studies of a number of select commercially available types of diodes and transistors were conducted to support these calculations. Radiation sources used were Co^{60}, a pulsed reactor, and a linear accelerator. These sources provided gamma flux pulse widths from d-c to 0.02 microseconds. Experimentally determined sensitivities were in substantial agreement with calculated sensitivities. It is concluded that this type of detector offers considerable promise for a wide variety of applications. Further increase in device sensitivity and frequency response for some of these applications will be required. (auth)

3186 (UCRL-6505) SOLID STATE NEUTRON DETECTORS. James F. Murphy (California. Univ., Livermore. Lawrence Radiation Lab.). May 1961. Contract W-7405-eng-48. 44p.

Thesis submitted to Naval Postgraduate School, Monterey, Calif.

Two methods of fabricating neutron detectors were developed based upon the principles of the solid state ionized particle detector. The (n,α) reactions of Li^6 and B^{10} are used for slow neutron detection. The lithium and boron are used as diffusants, for p- and n-type silicon respectively, to create p-n junction diode detectors with efficiencies of the order of 1%. The fission of U^{235} is used for the detection of both slow and fast neutrons. The U^{235} is vacuum-coated onto surface barrier detectors. Efficiencies of 0.004% were obtained from these units in a thermal beam from the Livermore 2-Mw pool-type reactor. (auth)

3187 (UCRL-9816) MODEL VI LINEAR AMPLIFIER SYSTEM AND PREAMPLIFIER. William W. Goldsworthy (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 14, 1961. Contract W-7405-eng-48. 19p.

Design details and operating characteristics of a Model VI Linear Amplifier System and a Model VI Preamplifier are described. The Model VI Linear Amplifier is a stable, low noise, moderate bandwidth, feedback amplifier which has extreme flexibility and good overload immunity. It is designed to handle pulses and waves with a wide variety of shapes, durations, and repetition rates. The Model VI Preamplifier was developed as a low noise, high stability, multipurpose preamplifier with either charge-sensitive or voltage-sensitive operation. It is compatible with solid-state, ionization-proportional, geiger, or scintillation detectors. (auth)

3188 (WT-1155) MEASUREMENTS OF AIR-BLAST PHENOMENA WITH SELF-RECORDING GAGES. E. J. Bryant, N. H. Ethridge, and J. H. Keefer (Ballistic Research Labs., Aberdeen Proving Ground, Md.). July 16, 1959. Decl. Aug. 2, 1961. 210p. Project 1.14b [of] Operation TEAPOT.

The self-recording mechanical gages developed for recording overpressure and dynamic pressure as functions of time were installed on 12 shots. For several shots more than one blast line was instrumented. In addition to these blast lines, gage stations were prepared in locations to meet specific data requirements, such as in the vicinity of structures, and in particular on a circle of gages at a radius of 2500 feet on Shots 12 and 14. Furthermore, a very-low-pressure gage was employed to record the wave shapes and magnitudes at large distances from the explosions. Particular application of this gage was made on Shot 10. The gages performed well, and the results were a wealth of data on a wide range of yields for a variety of surface conditions. Tabulations are presented of peak overpressure, positive-phase duration and arrival times at ground surface, and peak dynamic pressure, peak total overpressure, and peak static overpressure at the 3-foot level. The curves for peak overpressure and peak dynamic pressure as functions of distance are shown plotted as observed and reduced to 1 KT at sea level in comparison with appropriate curves from TM 23-200 and ideal pressure-distance curves. Comparisons are shown between gage results under a smoke layer and on clear desert for Shot 5, between gage results on asphalt and desert surfaces of Shot 6, and between gage results on asphalt, desert, and water surfaces of Shot 12. Comparisons are also made of gage results of various shots with similar conditions. The data indicated that precursors formed on all shots instrumented except the first: gage failure to record pressure-time histories provided no data for determining precursor formation on this shot. Precursor formation over asphalt was more pronounced than over the desert or water surface. The rate of propagation and the positive phase duration were increased and overpressures decreased on the asphalt more than on the desert or the water surface. The good-surface-condition curve and the poor-surface-condition curve of TM 23-200 bracketed the measured overpressure curves within the precursor zone. The more pronounced the precursor, the greater is the depression of the measured overpressure-distance curve. The smoke layer during Shot 5 reduced the thermal effects. The presence of a precursor affecting shock-wave parameters will depend on surface conditions and the height of burst and yield of the weapon or device. The enhancement of dynamic pressure will depend on surface conditions and is related to the depression of the overpressure-distance curve. An analytical method was used which describes the differences between the measured dynamic pressure and ideal dynamic pressures. This method can be used to predict fairly well the dynamic pressures over an asphalt surface but will

underestimate the dynamic pressure over a desert surface. (auth)

3189 (Y-1363) IN VIVO GAMMA LUNG MEASUREMENTS—A MATHEMATICAL MODEL. P. R. Ammann, C. W. Wilson, and C. M. Mohr (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Oct. 20, 1961. Contract W-7405-eng-26. 60p.

A low-background facility is described for measuring lung burdens of U, Th, and other nuclides in vivo. Problems associated with this method of radiation measurement are discussed. A mathematical, computer-oriented simulation was devised to gain insight into the relation of the net observed radiation spectrum to the burden of radioactivity in the body or its organs. Chest cavities for persons of three sizes were synthesized in a three-coordinate space comprised of one-inch cubes and including a 9-in.-diameter crystal detector. Data, describing the tissue composition of each cube in the body and the characteristic radiation attenuation for each tissue-type, were coded for use with a program on a high-speed digital computer. Efficiencies for measuring radiation emitted by numerous point sources of enriched uranium were calculated. Data on in vivo measurement efficiency were obtained assuming uniform distribution of radioactive material throughout the lungs and also for nonuniform deposits. The effects of individual size and geometry, and of detector position on the measurement efficiency were determined for these two categories and radiation flux distributions on the detector face were computed in some cases. Data are appended and a flow diagram of the computer program is included. (C.H.)

3190 (AEC-tr-3973(Pt.II and Add.)(p.939-55) ELECTRONIC METHODS OF ULTRASHORT PULSE GENERATION. A. S. Koropskii, A. V. Chernetskii, N. V. Korotkikh, and V. I. Voznesenskii. Translated from Uspekhi Fiz. Nauk, 63: 801-12(1957).

A review of information concerning pulse engineering is presented. The basic characteristics of pulse generators are examined and a survey of existing generators is presented. (J.R.D.)

3191 (CEA-tr-A-996) UNE THEORIE DE L'APPAREILLAGE D'OBSERVATION DE RESONANCES MAGNETIQUES NUCLEAIRES. (A Theory of Equipment for Observation of Nuclear Magnetic Resonances). H. Pfeifer. Translated into French by P. Monnard from Ann. Physik (6), 15: 311-24(1955). 30p.

A theory of the apparatus used for the observation of nuclear paramagnetic resonance phenomena was developed. It was verified that it is not necessary that the variation of the voltage caused by the passage of the resonance agree with that which the magnetization or the susceptibility of the sample would present in the case of a variable magnetic field of high frequency with constant amplitude and frequency. This is important for studies of structures since it is precisely in this case that the shape of the lines will permit adequate conclusions to be established. Moreover, a certain variation with respect to the resonance condition $\omega = \gamma H$ (γ = gyromagnetic ratio of the nucleus type) appears which depends on T_2, time of transverse relaxation. (tr-auth)

3192 (CEA-tr-R-1236) MÉTHODE DE STABILISATION DE LA SENSIBILITÉ DU SYSTÉME AMPLICATEURS-PHOTOÉLEMENT D'UN COMPTEUR Á SCINTILLATIONS. (Method of Stabilization of the Sensitivity of Amplifier-Photoelement Systems in Scintillation Counters). A. Z. Barkan (Barban) and A. S. Kudryashev (Kudriashev). Translated into French from Russian Patent CAR 124,554 from Byulletin Izobret., No. 23, 1959. 4p.

In order to stabilize the sensitivity of the amplifier-photoelement system of a scintillation counter, the photoelement is exposed to a standard light simultaneously with the pulse to be measured. The voltage of the photoelement corresponding to this standard light flux is used for the automatic regulation of the amplification of the amplifier system. (J.S.R.)

3193 (JPRS-8937(p.109-19)) ON THE PROCESS OF THE PREPARATION OF NUCLEAR EMULSIONS N-2 AND N-3. Tse-hui Ho, Tsu-yin Lu, and Han-cheng Sun. Translated from Wu Li Hsüeh Pao, 15: No. 3, 131-7(Mar. 1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 370.

3194 (JPRS-8937(p.120-6)) METHODS OF PREPARATION AND CHARACTERISTICS OF NUCLEAR EMULSIONS N-2, N-2 LOADED WITH BORON. N-2 LOADED WITH LITHIUM, N-3, N-4, N-5. Tsu-yin Lu, Han-cheng Sun, Hui-chang Liu, and Tse-hui Ho. Translated from Wu Li Hsüeh Pao, 15: No. 3, 139-44(Mar. 1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 371.

3195 (JPRS-10833) TROKHOTRON. M. Maksimov. Translated from Radio, No. 11, 57-60(1953). 14p.

The trochotron is an electron-beam device which permits the generation, modulation, demodulation, and counting of pulses; measurement of time intervals from microseconds to minutes; and the switching of electrical circuits. The design and principles of operation of the device are described. (B.O.G.)

3196 (NP-tr-815) RADIATION MONITOR AND MEASUREMENT. S. Moriuchi (Japan. Atomic Energy Research Inst., Tokyo). Translated by Y. L. Chow (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Report No. JAERI-5002(2), 1960. 5p.

Attempts to construct an ionization chamber free from beta interference as well as a large-volume standard ionization chamber for beta radiation are described. These studies were made in the development of an ionization chamber for measurement of background. Calibration of G-M counters for measurement of airborne beta and gamma dose rates is discussed. Isolation of the beta dose and conversion coefficient determinations are described. (M.C.G.)

3197 APPARATUS DRAWINGS PROJECT. REPORT NUMBER 21. IONIZATION CHAMBER. Robert G. Marcley (American Inst. of Physics, New York). Am. J. Phys., 29: 845-50(Dec. 1961).

A simple parallel-plate ionization chamber of the integrating type is described. It was specifically designed for undergraduate investigations of the effects of ionizing radiation on a gas under the influence of a relatively small electric field. A simple gas handling system permits operating the chamber with air or several pure gases at any pressure from a few mm Hg up to several atm. Gamma rays easily penetrate the chamber envelope, while collimated beams of α, β, and soft x radiation can be passed through a thin window into the sensitive region between the rectangular plates. Ancillary apparatus required for experiments consists of 0 to 100 v potential source, an electrometer capable of measuring a current of 10^{-13} amp full scale, and a small mechanical vacuum pump. Construction details are given. (auth)

3198 A CONTINUOUS FLOW MONITOR FOR SCANNING ^{32}P-CONTAINING EFFLUENTS FROM CHROMATOGRAPHY COLUMNS. A. R. Krall and L. P. Zill (Research

Inst. for Advanced Studies, Baltimore). Anal. Chim. Acta, 25: 457-60(Nov. 1961). (In English)

A continuous flow monitor is described. The separation of P^{32}-labeled compounds from barley is presented as an illustration of the results obtained with the system. (auth)

3199 ON THE ACCURACY OF A NANOSECOND TIME-TO-AMPLITUDE CONVERTER. Teuvo Kohonen (Finland Inst. of Tech., Otaniemi). Ann. Acad. Sci. Fennicae, Ser. A, VI, No. 79, 1-15(1961). (In English)

A time-to-amplitude converter accuracy was evaluated by measuring the time difference of delayed gamma-gamma coincidences. The accuracy of the converter is shown by determining the mean lives of positrons in aluminum, paraffin, and sodium. Only the instrumental aspects are considered; little reference is made to the physical phenomena. The circuit diagram of the detectors and the converter are given for the scintillator-photomultiplier assembly. (N.W.R.)

3200 SAFE, RELIABLE PROCESS MONITORING. PART I: WHAT'S NEEDED. R. Sherrard (General Electric Co., Richland, Wash.). Control Engineering, 7: 87-91 (Dec. 1960).

The functions required to assure the reliability and failsafe operation of process reactor monitoring systems are discussed. It is shown that regardless of the process under consideration, safe and reliable monitoring depends on the reliability of the transducers, the reliability of the way in which they are used, and the reliability of the monitoring system itself. The process used to illustrate this discussion, the Hanford reactor, is far from common. Its reliability and safety, however, are very much like those of other critical processes. Of the two basic system types described, the data sampling type appears to have far more to offer than the currently used continuous type. (N.W.R.)

3201 SAFE, RELIABLE PROCESS MONITORING. PART II: SELECTION, DESIGN, AND SPECIFICATION. R. Sherrard (General Electric Co., Richland, Wash.). Control Engineering, 8: No. 2, 111-14(Feb. 1961).

The selection, design, and specifications required for safe and reliable process monitoring systems are discussed in regards to experience obtained on the Hanford reactor systems. Thus to improve over-all monitoring reliability the following steps should be taken: selection of proven transducers and arrangement of a system configuration that includes failsafe circuits and logic testing. This information must also be included in the systems specification, a document that incorporates customer experience in a way that guides the vendors to produce a safe, reliable monitoring system. (N.W.R.)

3202 THE "BODY-COUNTER." L. H. M. van Stekelenburg. Electrotechniek, 39: 614-18(1961). [(In Dutch)]

The need of whole-body monitoring for radiation workers handling radioisotopes is pointed out. Some data about maximum permissible body burdens are provided and the technique of measuring human radioactivity is described. Some details are given of a body counter to be built at the KEMA laboratories at Arnhem. (NPO)

3203 THE IONIZATION CHAMBER AS A MEASURING STANDARD FOR THE ACTIVITY OF BETA EMITTERS. K. K. Aglintsev. Izmeritel'naya Tekh., No. 9, 39-42(Sept. 1961). (In Russian)

The 4π counter measures beta activities from 10^{-11} to 10^{-7} curies; the organic scintillation counter measures activities up to 10^{-5} curies; a calorimeter can be used to measure activities of 0.01 curies and higher. An extrapolation ionization chamber can be used to fill the gap between 10^{-6} and 10^{-2} curies. The electrodes are shifted to cause a change in ionization volume of $V_1 - V_2$, and a change in ionization current of $I_1 - I_2$. With a specific activity of the source of q = 1 curie/g, a density of ρ = 1 g/cm^3 and a source thickness of 0.1 mg/cm^2, calculations for S^{35} (167 kev), W^{185} (430 kev), Tl^{204} (765 kev), Y^{91} (1560 kev), and P^{32} (1690 kev) show that the dose strengths P in a volume $V_1 - V_2$ at a solid angle of 0.024 are 12, 7, 4, 3.3, and 3×10^{-3} rads/sec. The ionization current $I_1 - I_2$ and the energy resolution can be increased by increasing the area to S = 10 cm^2. The average dose strengths are then calculated to be 0.12, 0.10, 0.09, 0.07, and 0.07 rads/sec. If the thickness of the source is increased to 100 mg/cm^2, the average dose strengths are calculated as 2.8, 9.5, 17, 27, and 28 rads/sec. Calculated values of $I_1 - I_2$, show that the ionization current is increased by a factor of 1000 to 2000 on increasing the area of the source from 0.1 cm^2 to 10 cm^2. On increasing the source thickness from 0.1 to 100 mg/cm^2, the ionization current $I_1 - I_2$ increases by factors of 23, 92, 190, 380, and 395 for these isotopes. A thick source of 100 mg/cm^2 and an area of 10 cm^2 are recommended in order to obtain suitable ionization currents. (TTT)

3204 THE DETERMINATION OF THE RESOLVING TIME OF A COUNTER. V. M. Prokhorov. Izmeritel'naya Tekh., No. 9, 42-3(Sept. 1961). (In Russian)

The ordinary method of measuring the dead time of a counter includes the simultaneous measurement of the count rates of two radioactive sources. In order to avoid the inconvenience of mounting two sources, the dead time can be determined by making two measurement counts (instead of three) of a radioactive source with and without a metallic filter of a given thickness. The dead time is then given by the relation: $\tau = (A\bar{I} - I)/\bar{I}(A - 1)$, where A is the ratio of the count rate without a filter to the count rate with the filter for a source with a small amount of activity which need not be corrected for dead time. The term $\bar{I}$ is the count rate through the filter, and I is the count rate without the filter. A more accurate formula is derived for large values of $I\tau$. The results of measurements on a $Sr^{90} + Y^{90}$ source show that this method compares in accuracy with the usual method of determining dead time. (TTT)

3205 STATISTICAL CONTROL OF RADIOMETRIC EQUIPMENT. I. M. Nazarov. Izmeritel'naya Tekh., No. 9, 43-5(Sept. 1961). (In Russian)

The count rate obtained from a piece of equipment operating satisfactorily follows a Poisson distribution. Disturbances introduced by aging of the Geiger tube, nonstable operation of the photomultiplier, incorrect adjustment of the discriminator, amplifier, or feed supply, and by defects in the mechanical counter result in a distribution which is considerably different from a Poisson distribution. The essence of the method of quality control consists in evaluating the relation $f \cdot S^2/\bar{x}$ from the results of a series of measurements. A nomogram to determine the number of measurements is presented, where the deviation $y = \sigma^2/\bar{x}$ from the expected dispersion is given for a probabilities $p(\sigma^2)$ of 88%, 95%, 99% and 99.5% at a significance of α = 0.05. The curves can also be used to find the deviation y for a given number of measurements and a given probability. (TTT)

3206 A SCANNING FABRY-PEROT INTERFEROMETER. William L. Barr and Andrew L. Gardner (Univ. of California, Livermore). J. Opt. Soc. Am., 51: 1400-1(Dec. 1961). (UCRL-6395)

A simple method of photoelectrically scanning a Fabry-Perot interferometer pattern is described. Scanning is

accomplished by parallel displacement of the incident beam of light across the face of an interferometer whose plate separation varies in the direction of the displacement. This method of scanning allows a slightly distorted plot of the line profile to be continuously displayed on an oscilloscope. (auth)

3207 DIAGNOSTIC AND SCINTILLATION APPARATUS OF THE DCY-60 TYPE. I. K. Tabarovskii, Yu. B. Mandeltsvaig, I. M. Gofman, V. A. Benyush, V. I. Popov, and Yu. A. Akatov (All-Union Scientific-Research Inst. of Medical Instruments and Apparatuses, Ministry of Public Health, USSR). Med. Radiol., 6: No. 9, 64-7(Sept. 1961). (In Russian)

A block diagram is given of a diagnostic scintillation unit capable of measuring I^{131} accumulation (from 1 to 5 μc) with an order of accuracy of ± 5%; measuring time is 30 sec to 4 min. (R.V.J.)

3208 THE U. S.–CANADIAN FAST CHOPPER INSTALLATION AT CHALK RIVER. R. L. Zimmerman (Brookhaven National Lab., Upton, N. Y.), H. Palevsky, R. E. Chrien, W. C. Olsen, P. P. Singh, and C. H. Westcott. Nuclear Instr. & Methods, 13: 1-20(Aug. 1961). (In English)

The physical arrangements and characteristics of the joint Brookhaven-AECL fast chopper installation at the NRU reactor in Chalk River are described. For flight paths similar to those previously used at Brookhaven the increase in intensity renders new classes of experiments feasible, while with an 88-meter flight path a resolution of 15 ns/m becomes possible for total cross section studies. (auth)

3209 AUTOMATIC ANALYSIS OF BETA-RAY SPECTRA. Werner Schneider and Torsten Lindqvist (Univ. of Uppsala). Nuclear Instr. & Methods, 13: 21-8(Aug. 1961). (In English)

The analysis of beta spectra is programmed for an electronic computer. As an application, the analysis of the line spectra obtained in a magnetic semicircular beta spectrograph is described, as well as the Kurie-analysis of a continuous beta-spectrum. (auth)

3210 SORTING OF TWO COINCIDENT PULSES ACCORDING TO THEIR AMPLITUDES. M. Konrad and B. Turko (Institute "Rudjer Bošković", Zagreb). Nuclear Instr. & Methods, 13: 29-34(Aug. 1961). (In English)

Systems are described for sorting coincidences of two pulses according to their amplitudes into channels of an analyzer. The amplitude of pulse A is divided into N amplitude channels and of pulse B into M channels. If the amplitude a of pulse A is in the amplitude channel n and of pulse B in channel m, the event is placed into the T = nM + m channel. The comparator of an amplitude analyzer is replaced by another one, consisting of two amplitude to time converters, which are connected so that either the total time of conversion is proportional to T (with circulating memory), or the number of output pulses equals to T (with ferrite memory). Block diagrams of these comparators are given, and a comparator is described which is used at the Institute "Rudjer Bošković" with a modified Hutchinson type analyzer. (auth)

3211 A LOW BACKGROUND BETA-RAY SCINTILLATION SPECTROMETER USING A COINCIDENCE METHOD WITH A GEIGER COUNTER. Eiichi Tanaka (National Inst. of Radiological Sciences, Kurosuna-cho, Chiba-shi, Japan). Nuclear Instr. & Methods, 13: 43-9(Aug. 1961). (In English)

The design and performance of a new type β-ray scintillation spectrometer suitable for measuring very low β activities of solids are described. The spectrometer consists of a scintillation counter using a plastic scintillator and a gas flow G-M counter located in a hollow of the scintillator, and the coincidence operation between these two counters is applied. Cosmic ray counts are rejected by pulse height analysis. Inside the 10 cm lead shield the background counting rate is less than that of conventional low background counters using anti-coincidence shields, and a typical background counting rate of 0.15 cpm for the energy range from 0.5 to 2.5 Mev is obtained. This system can also be used as a low background counting device in a limited energy range. For relatively high energy β emitters, the coincidence countings are used between scintillation pulses and G-M pulses. In this case, the background is reduced by rejecting cosmic ray counts, high and low energy components of the γ background and noise or spurious counts of the detectors. For low energy β emitters, on the other hand, the anti-coincidence countings are suitable, then the cosmic ray counts and high energy components of the γ background can be rejected. (auth)

3212 G. M. DETECTOR FOR BETA SPECTRA. Jean Kern (Université, Fribourg, Switzerland). Nuclear Instr. & Methods, 13: 50-4(Aug. 1961). (In French)

The dependence of the slope of the plateau of a G-M counter upon counting rate is measured with two modes of irradiation. Also a twin Geiger-Müller counter is described. Its operational characteristics are given. The slope of the plateau of the two counters in coincidence is less than 1%/100 v when the counting rate is 120 counts/sec in each tube. The plateau length exceeds 300 v. The background is reduced by a factor of approximately 5 compared with single counting. Peak counting rates up to 1500 coincidences/sec are used without any difficulty. (auth)

3213 A TWENTY-Mc/s TRANSISTOR DECADE SCALER. T. K. Alexander and D. R. Heywood (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nuclear Instr. & Methods, 13: 83-91(Aug. 1961). (In English)

A transistor decade scaler that operates reliably at 20 Mc/s is described. The scaler has binary-coded decimal outputs isolated from its feed-back path. The circuit does not require close-tolerance components and it operates on negative pulses 0.7 to 3.5 v in amplitude. The carry delay through the decade is approximately 25 ns. A simple transistor pulse generator is also built and operates at repetition rates from 1 to 40 Mc/s; either a continuous train of pulses or bursts of pulses may be produced. The pulse width may be varied from 20 ns to one half the period of the oscillation. The generator produces both positive and negative pulses with a maximum amplitude of 2.5 v into 100 Ω. (auth)

3214 A LOW PRICED AUTOMATIC PRINTOUT SYSTEM FOR THE HUTCHINSON-SCARROTT ANALYZER. Richard C. McCall and E. Ingemar Larsson (Univ. of Lund, Sweden). Nuclear Instr. & Methods, 13: 92-4(Aug. 1961). (In English)

The Hansen readout system for the multi-channel Hutchinson-Scarrott pulse height analyzers is modified to an automatic printout system. The actual printout speed depends on the number of counts stored in the channels. With all channels empty, the printout proceeds at 2.5 channels per second. A sodium-22 spectrum is illustrated. The cost of the printout system is estimated at about $1000. (N.W.R.)

3215 A FAST FLIP-FLOP CIRCUIT UTILIZING TUNNEL-DIODES. Y. Hazoni (Atomic Energy Commis-

sion, Tel-Aviv, Israel). Nuclear Instr. & Methods, 13: 95-6(Aug. 1961). (In English)

The flip-flop circuit described is triggered symmetrically to switch in both directions as a result of pulses of the same polarity; instead of changing the polarity of the pulses there is a change of input channels. This change is performed automatically by the tunnel diode itself while changing its state. The ultimate speed of the fast bistable multivibrator circuit is the switching time of the tunnel diode, which could be better than one nanosecond. (N.W.R.)

3216 ELIMINATION OF THE DEAD SPACE BETWEEN CHANNELS IN A HUTCHINSON-SCARROTT PULSE HEIGHT ANALYSER. R. E. Jennings and R. E. Rand (University Coll. of Science and Tech., London). Nuclear Instr. & Methods, 13: 97-8(Aug. 1961). (In English)

The dead space between channels in a Hutchinson-Scarrott pulse-height analyzer is eliminated by connecting a small capacitor (10 to 15 pF) between the channel oscillator and the linear sweep so that the sweep has superimposed positive pips. This method prevents a coincidence occurring when a channel pip is due, thus the input pulse is held and recorded in the following channel. This sorting action is normal for each new channel. However, a pulse may not be counted in the next channel until the sweep again passes this level so that a time interval is created during which comparison is prohibited. This interval covers the dead time completely, due to the inherent delay of the circuits, and counts are no longer lost. The small displacement of the channel boundaries can be corrected. Results when measuring a uniform distribution of pulses are reduced from 3% to less than 10^{-4}%. (N.W.R.)

3217 A POSSIBLE METHOD FOR DISTINGUISHING CHARGED PARTICLES WITH SEMICONDUCTOR DETECTORS. N. Cindro (Institute "Ruder Bošković", Zagreb). Nuclear Instr. & Methods, 13: 99-100(Aug. 1961). (In English)

A method for distinguishing charged particles with a semiconductor detector consists of the following: if two particles of different kind (such as a proton and a deuteron) but with the same energy are stopped in the space charge region (depletion region) of a p-n junction or a surface barrier detector, they will produce the same voltage pulse. However, due to its higher specific ionization, the deuteron will have a shorter range in the crystal than the proton. If now the width of the depletion region is adjusted so as to have the exact thickness necessary to stop deuterons of a given energy, protons of the same energy will not be stopped completely in traversing the depletion region. Consequently, the proton voltage pulse will be smaller than that of the deuteron. Protons (and deuterons) of higher energy will lose less energy and give correspondingly smaller pulses, while lower energy particles will be ruled out by their smaller charge output. (N.W.R.)

3218 LARGE-AREA FLOW COUNTERS SPEED RADIATION MEASUREMENTS. Hans Kiefer and Rupprecht Maushart (Nuclear Research Center, Karlsruhe, Ger.). Nucleonics, 19: No. 12, 51-4(Dec. 1961).

The design concept and performance of a flow proportional detector with a particularly large counter area are described. The size and sensitivity (with anticoincidence circuits) of the proportional flow counters enable it to make faster and more accurate measurements of gamma radiation and alpha and beta particles. The advantages over scintillation counters and G-M counters are pointed out. Applications in air and waste monitoring and monitoring of surfaces are discussed. (T.R.H.)

3219 VAPOR-PHASE G-M COUNTERS FOR STUDYING ISOTOPIC EXCHANGE. Irving M. Pearson and Clifford S. Garner (Univ. of California, Los Angeles). Nucleonics, 19: No. 12, 60(Dec. 1961).

In order to follow a radioisotopic exchange reaction, vapor phase Geiger-Mueller counters are developed to continually measure the radioactivity of the gas that is in equilibrium with the solution. Thus as exchange occurs the change in activity of the gas phase under appropriate conditions is a measure of the exchange reaction rate. There are two reaction vessels for this measurement, one gun-shaped and one spherical, that can be evacuated and used at pressures as low as 10^{-4} mm Hg with solutions of chlorine-36 (0.71 Mev betas) in CCl_4. (N.W.R.)

3220 MEASURING DETECTOR DEADTIMES ACCURATELY. Sven Goesta Rudstam (CERN, Geneva). Nucleonics, 19: No. 12, 62-3(Dec. 1961).

A method is described for determining the over-all deadtimes of radiation detector systems. The method is a modification or a straightforward extension of the method of proportional sources. The deadtime by this method is given graphically with great accuracy, easily within one percent. The method differs from the usual method of proportional sources in the treatment of the measured data. Several examples are used to explain the method. (N.W.R.)

3221 WIDE RANGE CURRENT STABILIZATION WITH THE ACCURACY OF 10^{-4}. Z. Burzyński (Inst. of Nuclear Research, Warsaw). Nukleonika, 6: 71-83 (1961). (In French)

A device is described for wide range current stabilization with the relative accuracy of 10^{-4} measured during 4 hours of work. The accepted device scheme is discussed from the point of view of development tendencies in the technique of current stabilization. Dynamic stability is achieved with the aid of a simple selective feedback circuit in the last step of the amplifier. (auth)

3222 THE PARAMETERS OF RADIATION GAGES. J. Czarnecki. Nucleonika, 6: 85-97(1961). (In Russian)

The parameters of radiation gages working on the "on–off" principle are discussed. Graphical methods for selecting source size and various other parameters are given. (auth)

3223 APPLICATION OF A PLUTONIUM MONITOR IN STUDIES OF SURFACE POTENTIALS. B. Kamieński, J. Mikulski, J. Pawełek, and I. Stroński (Inst. of Nuclear Research, Krakow). Nukleonika, 6: 99-106(1961). (In German)

An attempt was made at application of the ionization method to measurements of surface potentials of some organic compounds which are physiologically active, using a plutonium isotope, Pu^{239}. The surface potentials were determined for Miltown and Cardiozol which are used in medicine. (auth)

3224 SOME PROBLEMS OF APPLYING THIN SODIUM IODIDE CRYSTALS IN GAMMA-RAY SPECTROMETRY WITHIN THE ENERGY RANGE 15–100 KEV. Ludwik Górski (Academy of Mining and Metallurgy, Kraków). Nukleonika, 6: 399-408(1961). (In English)

The method of cutting and mounting scintillation crystals of sodium iodide of the thickness of a few millimeters is described. Taking into account the effect of escape peak a graph is calculated giving total efficiency and efficiency in the main photoelectric peak of crystals of different thickness and for different energy. Some applications of thin crystals and of the graph giving their efficiency in the

gamma or x-ray spectrometry and industrial thickness meters are presented. (auth)

3225 EXAMINATION OF THE DENSITY OF RADIUM PREPARATIONS WITH THE AID OF A RAY PROTECTION MONITOR. Rolf A. Krause (Stadt. Rudolf-Virchow-Krankenhauses, Berlin). Röntgen Bl., 14: 321-5(Oct. 1961). (In German)

A description is offered of a method for examination of the density of radium preparations using a ray-protection monitor. (auth)

3226 A NEW β-SPECTROMETER OF THRICE-REPEATED FOCUSING OF HIGH ORDER. P. P. Zarubin, V. Yu. Padalko, and V. R. Saulit. Vestnik Leningrad. Univ., 16: No. 10, Ser. Fiz. i Khim. No. 2, 55-63(1961). (In Russian)

Calculation of the magnetic field giving triple focusing of charged particles without aberration is made. The table of the dependence of the magnetic field strength on the radius is given. A new type of β spectrometer based on the calculated field is suggested. This β spectrometer can be used as a γ spectrometer. (auth)

3227 MEASUREMENT OF ABSORBED DOSE OF NEUTRONS, AND OF MIXTURES OF NEUTRONS AND GAMMA RAYS. National Bureau of Standards Handbook 75. (National Bureau of Standards, Washington, D. C.). Feb. 3, 1961. 92p. (NCRP-25). $0.35(GPO).

A summary is presented of currently available methods for determining energy absorption in matter as a result of its interactions with neutrons. Mixtures of gamma radiation and neutrons were also studied. Methods of dosimetry and instruments and methods for determination of dose are described. Applications in radiobiology, radiation protection, shielding and neutron physics, and radiation effects studies are discussed. (M.C.G.)

3228 TECHNIK DES MESSENS RADIOAKTIVER STRAHLUNG. (Techniques of Measurement of Nuclear Radiation). Vitezslav Kment and Arno Kuhn. Leipzig, Akademische Verlagsgesellschaft Geest and Portig K. G., 1960. 616p. (In German)

The physical basis of radiation detection is outlined. The following types of radiation detectors are described: gas-filled detectors, ionization detectors, scintillation counters, secondary emission detectors, crystal counters, chemical detectors, and thermal detectors. Electric and electronic apparatus are discussed including: detector signals and their measurements, electrostatic measuring instruments, basic properties of amplifiers, tube voltmeters and electrometers, impulse apparatus, counting apparatus, and voltage sources for detectors. A description is also presented for integration apparatus, counting apparatus for activity measurements, counting apparatus for special purposes, and operation of measuring apparatus. A comparison of the different radiation detectors is also included. (M.C.G.)

3229 POISKOVO-RAZVEDOCHNAYA RADIOMETRICHESKAYA APPARATURA. (Radiometric Equipment for Prospecting and Surveying). A. L. Yakubovich. Moscow, State Publishing House of Scientific and Technical Literature on Geology and Ore Conservation, 1960. 206p.

The general principles of radiometric measurements and the elements of measuring devices are reviewed. Various types of radiometric apparatus, including γ-counters for aerial surveying, portable gas-filled and scintillation counters for field prospecting, heavy core sampling counters, and laboratory type equipment. (R.V.J.)

3230 MEANS FOR INDICATING A SIGNAL SOURCE. Wilfred Smith and Gwilym James Richards (to Hawker Siddeley Nuclear Power Co. Ltd.). British Patent 878,174. Sept. 27, 1961.

An arrangement of burst slug detection equipment for a reactor is described. The arrangement indicates which fuel element is defective by means of a number of indicators less than the total number of fuel channels whose coolant is monitored, without using a cyclic sampling technique which may miss a brief abnormal signal. In the arrangement, the signal detectors (one to each channel) are connected to the indicators according to a matrix pattern, that is, the detectors are arranged in a three-dimensional framework and those in any one plane connected to one indicator. The spatial location of the detector associated with the defective fuel element is then easily determined. (D.L.C.)

3231 IMPROVEMENTS IN OR RELATING TO TEMPERATURE MEASURING DEVICES FOR NUCLEAR REACTOR FUEL ELEMENTS. Piyatilleke Perera Guneratne (to United Kingdom Atomic Energy Authority). British Patent 883,674. Dec. 6, 1961.

A thermocouple cable suitable for thermometry in a reactor fuel element is sheathed in titanium which can be sealed to the magnesium or magnesium alloy sheath of the element. The advantages of titanium over stainless steel as a sheathing material for thermocouples are that titanium can be joined directly to magnesium and the radioactive half life of titanium is shorter. (D.L.C.)

3232 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR THE MEASUREMENT, INDICATION OR DETECTION OF POSITION OF AN OBJECT. (to United Kingdom Atomic Energy Authority). British Patent 883,781. Dec. 6, 1961.

An apparatus is designed for remotely indicating the position of an object, particularly a control rod in a reactor. The apparatus comprises a coil system and a movable core; the coil system has primary and secondary windings and the core is attached to the control rod and has spaced magnetic collars. The electrical output of the secondary windings is indicative of the relative positions of the core and coil system. (D.L.C.)

3233 ELECTRICAL COIL STRUCTURE. (to U. S. Atomic Energy Commission). British Patent 884,082. Dec. 6, 1961.

An electrical coil for use in high-current circuits such as in electromagnets is designed which requires only a small coolant pumping pressure. The coil comprises a long flat strip of electrical conductor wound in a tight spiral and having on one surface scored parallel transverse grooves which function as coolant passages. (D.L.C.)

3234 DIRECTIONAL COUPLERS. D. J. Nigg (to U. S. Atomic Energy Commission). U. S. Patent 3,012,210. Dec. 5, 1961.

A directional coupler of small size is designed. Stripline conductors of non-rectilinear configuration, and separated from each other by a thin dielectric spacer, cross each other at least at two locations at right angles, thus providing practically pure capacitive coupling which substantially eliminates undesirable inductive coupling. The conductors are sandwiched between a pair of ground planes. The coupling factor is dependent only on the thickness and dielectric constant of the dielectric spacer at the point of conductor crossover. (AEC)

3235 METHOD FOR SENSING DEGREE OF FLUIDIZATION IN FLUIDIZED BED. R. P. Levey, Jr. and A. H.

Fowler (to U. S. Atomic Energy Commission). U. S. Patent 3,012,848. Dec. 12, 1961.

A method is given for detecting, indicating, and controlling the degree of fluidization in a fluid-bed reactor into which powdered material is fed. The method comprises admitting of gas into the reactor, inserting a spring-supported rod into the powder bed of the reactor, exciting the rod to vibrate at its resonant frequency, deriving a signal responsive to the amplitude of vibration of the rod and spring, the signal being directly proportional to the rate of flow of the gas through the reactor, displaying the signal to provide an indication of the degree of fluidization within the reactor, and controlling the rate of gas flow into the reactor until said signal stabilizes at a constant value to provide substantially complete fluidization within the reactor. (AEC)

3236 PERSONAL RADIATION MONITOR. R. H. Dilworth and C. J. Borkowski (to U. S. Atomic Energy Commission). U. S. Patent 3,015,031. Dec. 26, 1961.

A transistorized, fountain pen type radiation monitor to be worn on the person is described. Radiation produces both light flashes in a small bulb and an audible warning tone, the frequency of both the tone and light flashes being proportional to radiation intensity. The device is powered by a battery and a blocking oscillator step-up power supply. The oscillator frequency is regulated to be proportional to the radiation intensity, to provide adequate power in high radiation fields, yet minimize battery drain at low operating intensities. (AEC)

Materials Testing

Refer also to abstracts 3135, 3291, and 3342

3237 (HW-64452) QUALITY EVALUATION OF ZIRCALOY-2 SHEATH TUBING. P. L. Farnsworth, H. P. Oakes, and R. B. Socky (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 8, 1959. Contract AT(45-1)-1350. 58p.

A testing scheme was developed for evaluating Zircaloy-2 fuel element sheath tubing. The scheme includes the eddy current, fluorescent penetrant, immersed ultrasonic flow, dampening capacity, flare, and radiographic tests. (D.L.C.)

3238 (R61CAP9(Rev.)) ULTRASONIC TESTING OF THIN WALL ZIRCALOY TUBING. W. A. Sawyer (Canadian General Electric Co., Ltd. Commercial Atomic Power Div., Peterborough, Ont.). Aug. 1961. For Atomic Energy of Canada Ltd., Chalk River, Ont. 18p. (AECL-1360)

An ultrasonic test was developed which will detect cracks $^1/_{15}$ of the wall thickness in either a transverse or longitudinal direction on 1 in. O.D. by 0.026 in. wall, 0.6 in. O.D. by 0.25 in. wall, and 0.6 in. O.D. × 0.017 in. wall Zircaloy tubing. (J.R.D.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

Refer also to abstracts 2868, 2869, 2870, 2871, and 3229

3239 (AFOSR-1623) THE CLIMATIC AND HYDROLOGIC FACTORS AFFECTING THE REDISTRIBUTION OF Sr^{90}. Technical Report No. 1. Final Report. J. R. Mather and J. K. Nakamura, with a section by C. W. Thornthwaite (Thornthwaite (C. W.) Associates. Lab. of Climatology, Centerton, N. J.). Sept. 1961. Contract AF49(638)-887. 110p.

The influence of climatic and hydrologic factors on the movement of Sr^{90} through the upper layers of the soil was investigated. Results show that over most regions in the U. S. of agricultural significance there is a fairly rapid movement of Sr out of the upper soil layers under the action of the naturally occurring water surplus. In the non-agricultural mountain areas, longer removal times were found. A mathematical model of movement was established which permits computation of Sr movement in the soil. A manual was prepared for use in using high speed computers to compute the factors of the daily water balance. (C.H.)

3240 (BM-RI-5864) IRON MOUNTAIN TITANIFEROUS MAGNETITE DEPOSITS, FREMONT COUNTY, COLO. R. M. Becker, S. S. Shannon, Jr., and C. K. Rose (Bureau of Mines. Denver Mining Research Center). Apr. 1960. 22p.

Magnetic, gravity, and geologic surveys were made to permit an estimate of the extent and magnitude of the Iron Mountain, Colorado, titaniferous magnetite deposit. Gabbro is the dominant rock type of the area. Within the gabbro are lenses of titaniferous magnetite, 5 to 25 feet wide and as much as several hundred feet long. These lenses comprise a zone which has scattered occurrences of magnetite for 2200 feet. To the west, the gabbro grades into a strip of pyroxenite that in turn borders a large monzonite mass. A wedgelike broadening of the pyroxenite with depth accompanied by little or no increase in the titaniferous magnetite is considered a reasonable interpretation of the field data. The iron deposits appear to be limited and discontinuous. (auth)

3241 (HW-69292(Rev.)) SOME MEASUREMENTS OF THE DEPOSITION OF MATTER AND ITS RELATION TO DIFFUSION FROM A CONTINUOUS POINT SOURCE IN A STABLE ATMOSPHERE. C. L. Simpson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1961. Contract AT(45-1)-1350. 26p.

Deposition experiments were performed on the area around Hanford, using zinc sulfide particles as tracer. The results indicate that deposition of matter can be very great and, in these cases, must be taken into account in any realistic understanding of the diffusion of particulates. The calculated exchange coefficients based on deposition data compare favorably with the results of other investigators. (D.L.C.)

3242 (TEM-567) RADIOACTIVE MANGANESE OCCURRENCES IN THE LOWER RIO ITAPICURU VALLEY, BAHIA, BRAZIL. Donald D. Haynes, Henry Mau, and Max G. White (Brazil. Comissão Nacional de Energia Nuclear and Geological Survey, Washington, D. C.). Apr. 1958. 9p.

Radioactive manganese deposits are found in two swamps and at one locality on the northeast bank of the Rio Itapicurú near Mosquete, municipio of Itapicurú, State of Bahia, Brazil. The occurrences are related to warm springs and consist of surficial manganiferous sinter and of sandstone impregnated with manganese. The known deposits range from 19 to 175 meters in length, from 3 to 50 meters in width, and average 25 centimeters in thickness. Radiometric determinations on 31 samples of manganiferous sinter ranged from 0.035 to 0.127 percent equivalent uranium oxide. The radioactivity is due principally to radium-226 and its daughter products. One sample of manganiferous sinter contained 0.19 percent equivalent radium-226. (auth)

3243 (TEM-943) RECONNAISSANCE FOR URANIUM IN THE COAL OF SÃO PAULO, SANTA CATARINA, AND RIO GRANDE DO SUL, BRAZIL. Donald D. Haynes, Charles T. Pierson, and Max G. White (Brazil. Comissão Nacional de Energia Nuclear and Geological Survey, Washington, D. C.). Jan. 1958. 17p.

Uranium-bearing coal and carbonaceous shale of the Rio Bonito formation of Pennsylvanian age were found in the States of São Paulo, Santa Catarina, and Rio Grande do Sul, Brazil. The uranium oxide content of the samples collected in the State of São Paulo ranged from 0.001 to 0.082%. The samples collected in Santa Catarina averaged about 0.002% uranium oxide; those collected in Rio Grande do Sul, about 0.003% uranium oxide. (auth)

3244 (TEM-1097) URANIFEROUS COAL AND CARBONACEOUS SHALE IN NORTHEAST PARANA, BRAZIL. Donald D. Haynes and Charles T. Pierson (Brazil. Comissão Nacional de Energia Nuclear and Geological Survey, Washington, D. C.). Jan. 1957. 20p.

Uraniferous coal was found in northeast Parana, Brazil, in the Rio Bonito formation of Pennsylvania age. In the majority of coal samples taken the uranium oxide content ranged from 0.005 to 0.030%, but selected screened samples contained as much as 0.445% uranium oxide. The sampled thickness of the coal seam ranged from 17 to 54 cm and averaged 31 cm. Channel samples across the entire thickness of the coal zone were taken in two places. All other samples were taken as grab samples from either mine waste dumps or coal zones that had high radioactivity. (auth)

3245 (TEM-1098) RECONNAISSANCE FOR RADIOACTIVE MINERALS IN THE SOUTHERN PART OF BRAZIL. Charles T. Pierson, Donald D. Haynes, and Evaristo Ribeiro, Filho (Brazil. Comissao Nacional de Energia Nuclear and Geological Survey, Washington, D. C.). Jan. 1957. 19p.

During 1954 to 1956 a reconnaissance for radioactive minerals was made with carborne, airborne and handborne scintillation equipment in the southern Brazilian states of Rio de Janeiro, São Paulo, Parana, Santa Catarina, and Rio Grande do Sul. During the traverse covering more than 5000 kilometers the radioactivity of Precambrian igneous and metamorphic rocks, Paleozoic, Mesozoic, and Cenozoic sedimentary rocks, and Mesozoic alkalic intrusive and basaltic extrusive rocks was checked. The 22 samples collected contained from 0.003 to 0.029% equivalent uranium oxide and from 0.10 to 0.91% equivalent thorium; two samples were taken from radioactive pegmatites for mineralogic studies. None of the localities is at present a commercial source of uranium or thorium; however, additional work should be done near the alkalic stock at Lages in the State of Santa Catarina and at the Passo das Tropas fossil plant locality near Santa Maria in the state

of Rio Grande do Sul. Near Lages highly altered alkalic rock from a dike contained 0.026% uranium oxide. At Passo das Tropas highly altered, limonite-impregnated sandstone from the Rio do Rasto group of sedimentary rocks contained 0.029% uranium oxide. (auth)

3246 (TEM-1104) RECONNAISSANCE FOR RADIOACTIVE ROCKS IN THE PAULO AFONSO REGION, BAHIA, BRAZIL. Donald D. Haynes and Henry Mau (Brazil. Comissão Nacional de Energia Nuclear and Geological Survey, Washington, D. C.). Jan. 1958. 78p.

Ground and air traverses were made to the northwest, north, and northeast of Paulo Afonso, Bahia, Brazil, covering Precambrian crystalline rocks and sedimentary rocks of the Jatoba series of Jurassic or Cretaceous age. No important radioactivity anomalies were found. Samples from the two strongest anomalies had an equivalent uranium oxide content of 0.002 and 0.006%. (auth)

3247 (JPRS-10418) CARBOCERNAITE — NEW RARE EARTH CARBONATE. A. G. Bulakh, V. V. Kondrat'eva (Kondrat'yeva), and E. (Ye.) N. Barnaova. Translated from Zapiski Vsesoyuz. Mineral. Obshchestva, 90: 42-9(1961). 11p.

A description is given of the conditions leading to the discovery of carbocernaite in the dolomite calcite carbonates in the Vuori-Yarvi Mountains on the Kola Peninsula, USSR. The physical properties, the chemical composition, and the results of the x-ray analysis of the mineral are discussed. It is pointed out that the affinity of this mineral to the voids in the dolomite calcite carbonates and its close association with sphalerite, ankerite, and chlorite suggest its hydrothermal genesis in the low temperature period of the postmagmatic formation of carbonates. The development under these conditions of carbocernaite, accompanied by ankilit and other rare earth minerals, agrees with the tendency of the rare earths toward autocrystallization in the ultrabasic alkaline mountain ranges of the Kola Peninsula. (B.O.G.)

3248 RADIOISOTOPIC ANALYSIS OF ROCKS AND SOILS FROM THE γ-RAY, ENERGY SPECTRUM TAKEN AT LOW ALTITUDES IN THE ATMOSPHERE. N. D. Balyasnyi, R. M. Kogan, M. V. Nikiforov, O. S. Renne, and Sh. D. Fridman (Inst. of Applied Geophysics, Academy of Sciences, SSSR). Doklady Akad. Nauk S.S.S.R., 140: 807-10(Oct. 1, 1961). (In Russian)

A 100-channel, scintillation counter with an 80 mm × 60 mm NaI crystal was used to determine the radioactivity of rocks and soils in situ at the earth's surface and a height of 25 meters in an airplane. Six gamma peaks belonging to RaC, RaC', ThC'', and K^{40} could be distinguished on the spectrogram. The concentration of K^{40} is a measure of the total amount of potassium. It is assumed that ThC'' and RaC' are in equilibrium with their natural decay products. In determining the concentration of K^{40}, ThC'', and RaC', the gamma-ray count is determined over four energy intervals (1.12 to 1.46; 1.46 to 1.60, 1.60 to 2.3 Mev and > 2.3 Mev) and at two photopeaks (1.46 Mev peak of K^{40} and 2.62 Mev of ThC''). The accuracy of the in situ determination is 10 to 12% for K^{40}, 12 to 15% for ThC'', and 15 to 25% for RaC'. It was found that the ratio ThC''/RaC' in a brecciated zone varies considerably from 6.2 to 11.8 due to the redistribution of radioisotopes in the process of quartz formation. The weight percent of thorium in equilibrium with ThC'', and of potassium in equilibrium with K^{40} were computed for a number of soils, and were found to be in good agreement with data for soils obtained by other methods. (TTT)

3249 THE PROBLEM OF THE QUANTITATIVE CONTROL OF THE PRODUCTS OF BENEFICIATION BY MEANS OF ALPHA-RADIATION. I. N. Plaksin and V. N. Smirnov. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 4, 118-22(July-Aug. 1961). (In Russian)

After deriving equations for the determination of elements in enriched ore samples after exposing them to α-radiation, the expressions obtained were experimentally verified. Synthetic minerals containing mixtures of fluorite with various additives were used together with Al_2O_3 containing added minerals. An (α,n) nuclear reaction or positron activity induced by α-particles registered the radiation effects. Quartz, feldspar, galenite, pyrite and baryte served as additives. The results were found to lie within the calculated 5% experimental error. If the concentration of the ore changes slowly, special calibrating curves may be used for determining the unknown component. Methods based on α-radiation are characterized by the fact that the determination is restricted to a 20-micron deep layer. The penetration of the particles may be even further decreased by using absorbing screens, restricting the determination to an extremely thin layer; this is of great interest for the study of physical-chemical surface phenomena which play a great role in mineralogy. (TTT)

3250 TRITIUM GEOPHYSICS. W. F. Libby (Univ. of California, Los Angeles). J. Geophys. Research, 66: 3767-82(Nov. 1961).

Rainfall from the northern and southern hemispheres has been analyzed for tritium. During the spring, summer, and early fall of 1959, in the northern hemisphere there was a peak in tritium fallout which was proportional to the peak in Sr^{90} fallout, whereas in the southern hemisphere there was no appreciable increase in either the tritium or the Sr^{90} fallout. It seems clear, therefore, that the peak in the northern hemisphere was due to the Russian nuclear bomb tests of October 1958, which injected large amounts of tritium and Sr^{90} into the stratosphere. The proportionality of the two fallout curves suggests that single molecules of water and fine particulate matter have the same residence time in the stratosphere and that the mixing of the stratospheric air with tropospheric air followed by rainfall scavenging must be the mechanism for removal of both from the atmosphere. The general rise in the tritium level due to hydrogen-bomb explosions has been found to be proportional to the total energy release, even though the bombs were fired under a variety of conditions. Therefore, rain and ground-water data can be interpolated and extrapolated so as to supply values for the tritium levels where samples were not collected and measured. The tritium method for determining the age of ground water (since it fell as rain) has been applied to several hydrological problems in southern California and elsewhere. The results confirm hydrological expectations in general but give some new detail and entirely independent checks. When more detailed applications have been made, it appears to promise to be an important tool for water management. Dead rains (abnormally low in tritium) were seen three times in 1960 in California. This, plus the proven low tritium concentration of upwelling water, strongly indicates that extensive areas of upwelling exist and that rains of short atmospheric life occur. (auth)

3251 AN EVALUATION OF A SIGNAL-SUMMING TECHNIQUE FOR IMPROVING THE SIGNAL-TO-NOISE RATIOS FOR SEISMIC EVENTS. L. H. Koopmans (Sandia Corp., Albuquerque, N. Mex.). J. Geophys. Research, 66: 3879-93(Nov. 1961).

Formulas are derived for evaluating as a function of

frequency the improvement in the root mean square signal-to-noise ratio for seismic events obtainable by the technique of summing the trace amplitudes recorded at a number of closely spaced seismometer stations. A modification of this technique whereby the signals are corrected for phase shift before summing is also studied. The theory is applied to noise data from a three-station network for the ranges of periods 6.7 to 20 sec and 0.25 to 1 sec. The signals in the short-period range are taken to be P and S body waves. Rayleigh waves are used in the long-period range. Improvement comparable to and occasionally in excess of that expected for uncorrelated noise is indicated for the modified technique in the short-period range, whereas little improvement is obtained in the long-period range for the given station spacing and noise conditions. (auth)

3252 PERMEABILITY MEASUREMENTS OF ROCK SALT. Earnest F. Gloyna and Tom D. Reynolds (Univ. of Texas, Austin). J. Geophys. Research, 66: 3913-21 (Nov. 1961).

A method is described for measuring the permeability of rock salt. Different specimens of salt were studied, and the technique was checked by use of a solid crystal of sodium chloride. Both reactive and nonreactive fluids were used in collecting permeability data. Permeability tests were run on rock salt from both dome and bedded formations. The dome salt was found to have a very low permeability, and the bedded salt was found in general to be impermeable. Where there was some measurable permeability under the conditions of the test, it was found that the permeating flow occurred through cracks or fractures in the salt and not through the crystals themselves. These fractures were apparently caused by the relaxation of stress which occurs when underground samples are removed from a compressed formation. The dome salt was found to have more fractures than the bedded salt, owing probably to its lower elastic strength. Such surface fractures, found in both types of salt, will be localized in the vicinity of a mine and consequently will not extend throughout a formation. (auth)

3253 CONTAMINATION OF POLISH SOILS BY ^{90}Sr. Antoni Domnicz, Aleksy Jagielski, Tadeusz Lityński, Barbara Łazarska, and Roman Łazarski (Inst. of Agriculture, Kraków). Nukleonika, 6: 135-8(1961). (In Polish)

The contamination of Polish soils by Sr^{90} is discussed. Results of several soil samples are given for samples taken in southern Poland. The calcium and strontium precipitates are obtained by a method used in American laboratories. The activity measurements are made with a Polish apparatus. The results show that the method applied and the apparatus utilized allow measurements of sufficient accuracy, and the degree of contamination by radioactive strontium approaches the order of magnitude quoted in the literature for the European Continent. (auth)

3254 GEOCHEMIA IZOTOPOW. (Isotope Geochemistry). Antoni Polanski. Warsaw, Wydawnictwa Geologiczne, 1961. 401p.

An account is presented of up-to-date knowledge of isotope geochemistry. The review contains the mechanical and geological aspects of the isotopes. Geochronology is described and methods for determining absolute geological age are outlined. The problems of the geological time scale and the age of the Earth's crust are also discussed. Of special note is the geochemistry and radiology of uranium and thorium. (N.W.R.)

3255 PRELIMINARY GEOLOGIC MAP OF THE SLICK ROCK DISTRICT, SAN MIGUEL AND DOLORES COUNTIES, COLORADO. D. R. Shawe, G. C. Simmons, and W. B. Rogers (Geological Survey, Washington, D. C.). Mineral Investigations Field Studies Map MF-203. 1961. $0.50(USGS).

3256 GEOLOGY OF THE MONROE QUADRANGLE, UTAH. Eugene Callaghan and Raymond L. Parker (Geological Survey, Washington, D. C.). Map GQ-155. 1961. (USGS).

3257 PRELIMINARY GEOLOGIC MAP AND SECTION OF THE MOUNT PEALE 2 NW QUADRANGLE, SAN JUAN COUNTY, UTAH. G. W. Weir, V. C. Kennedy, W. P. Puffett, and C. L. Dodson (Geological Survey, Washington, D. C.). Mineral Investigations Field Studies Map MF-152. 1961. $0.50 (USGS).

HEALTH AND SAFETY

Refer also to abstract 3117

3258 (CVNA-27(Pt.B, Vol.II)) PRELIMINARY HAZARDS SUMMARY REPORT. PART B. LICENSE APPLICATION. VOLUME II. (Carolinas Virginia Nuclear Power Associates, Inc., Charlotte, N. C. and Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). July 15, 1959. 208p.

A description of the preliminary design of the Parr Shoals Reactor and plant are presented. The information is based on a conceptual design, and while the ultimate plant will likely be similar to that shown, it may differ significantly because of refinements. Drawings and sketches are included. (J.R.D.)

3259 (DPR/INF/264) THE PACKAGING, TRANSPORT AND RELATED HANDLING OF RADIOACTIVE MATERIALS. F. R. Farmer (United Kingdom Atomic Energy Authority. Authority Health and Safety Branch, Risley, Lancs, England). Sept. 1961. 13p.

Some of the requirements for the safe handling and transport of radioactive and fissile materials are reviewed. Topics discussed include the properties of radioactive materials, the range of hazards associated with radioactive material, the control of radiation emitted from packages of radioactive material, types of transport containers, accepted tests for containers, and the status of national and international regulations for the safe handling of radioactive materials during transport. (C.H.)

3260 (HW-68081) STRONTIUM-90 SHIPPING CASK DESIGN CRITERIA AND HAZARDS EVALUATION. C. W. Smith (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 13, 1961. Contract W-31-109-Eng-52. 59p.

A cask was designed for shipping a maximum of 168,000 curies of Sr^{90} along with the associated impurities from Hanford to the Martin Nuclear Company and Oak Ridge National Laboratories. The cask was designed to completely contain the Sr^{90} while being decelerated at greater than 50 G. The cask is protected by an external buffer to assure that the deceleration does not exceed 50 G and also distribute the forces arising from striking sharp objects or solid surfaces. The cask has sufficient shielding to reduce the radiation levels to those required by the ICC. The cask surface temperature will be about 230°F and the maximum fission product temperature will be about 453°F during normal operation with the maximum permissible heat generation rate of 11,600 Btu/hour. Before releasing the cask the heat generation rate and the pressure buildup must be measured. To assure safe shipment it is necessary that the decay heat rate does not exceed 11,600 Btu /hour, that the equilibrium pressure is less than 100 psig, and that there are no helium leaks at the cask closures. Procedures for loading and unloading were developed. (auth)

3261 (HW-69587(Rev.)) SAFETY REVIEW OF HANFORD LABORATORIES PILOT PLANT FACILITIES. Revised by W. A. Snyder (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 10, 1961. Contract AT(45-1)-1350. 15p.

The safeguards incorporated by design features and administrative controls in Hanford laboratories and pilot scale facilities employed in handling fission products and plutonium are discussed. The facilities discussed are the Hot Semiworks, High-Level Radiochemistry Facility, Plutonium Fabrication Pilot Plant, Plutonium Metallury Laboratory, and Radiometallurgy Laboratory. (D.L.C.)

3262 (JAERI-6008) BASIC KNOWLEDGE OF SAFETY HANDLING OF RADIATION. (Japan Atomic Energy Research Inst., Tokyo). Aug. 1961. 28p. In Japanese.

Safety in the handling of radioactive materials is discussed. Topics covered include properties of radiation and its permissible dosage, survey meters, devices for measuring individual external exposure, rubber gloves, oxygen inhaler, and reference data. (M.C.G.)

3263 (NAVDOCKS-TP-PL-8) PERSONNEL PROTECTIVE SHELTERS. (Bureau of Yards and Docks). June 15, 1953. 61p.

Broad principles are elucidated upon which a shelter program may be based. Detailed information and criteria are outlined for use during the design phase of new permanent-type construction and later conversion of parts of buildings to shelter areas. Adaption details (gasproofing, equipment installation, etc.) required to convert a building for personnel shelter use are described. Single-purpose shelters are also discussed. (D.L.C.)

3264 (SC-4610(RR)) ENVIRONMENTAL BETA-GAMMA RADIOACTIVITY IN AIR AT SANDIA LABORATORY, THIRD QUARTER 1961. R. E. Womelsduff (Sandia Corp., Albuquerque, N. Mex.). Oct. 1961. Contract [AT (29-1)-789]. 10p.

A report is presented of the gross beta-gamma radioactivity (expressed as micromicrocuries per cubic centimeter of air) of air samples collected by Environmental Health Division of the Sandia Laboratory of Sandia Corporation during the Third Quarter of 1961. (auth)

3265 (TID-7615) PROCEEDINGS OF ANNUAL NUCLEAR MATERIALS MANAGEMENT MEETING, DENVER, COLORADO, JUNE 15, 1961. (Division of Nuclear Materials Management, AEC). 131p.

Included are 12 papers; each is abstracted in NSA. (P.C.H.)

3266 (TID-7615(p.1-6)) MATERIALS MANAGEMENT IN THE NUCLEAR RAMJET PROPULSION PROGRAM—PLUTO. O. L. Meadors (California. Univ., Livermore. Lawrence Radiation Lab.).

Discussion is given on two phases of the Lawrence Radiation Lab's Pluto Program, Hot Box and Tory II-A, which serve to indicate the extremes required to control high dollar value materials. The core and materials control of Hot Box are evaluated, along with the core design and fuel element inspection for Tory II-A. (P.C.H.)

3267 (TID-7615(p.7-13)) APPLICATION OF STATISTICAL TECHNIQUES FOR THE RELIABILITY OF NUCLEAR MATERIALS. Robert H. Anderson (Rocketdyne, Div. of North American Aviation, Inc., Canoga Park, Calif.).

Discussion is given on the application of statistical techniques for SS materials at Atomics International, which is building nuclear power reactors at Hallam, Nebraska, and Piqua, Ohio. To provide the correct quality assurance, the techniques of variable sampling based on MIL-STD-414 were employed to control phases of the process for fabricating fuel elements. Statistical techniques are also being integrated into the accountability system to provide 95%

confidence limits on weights and chemical analysis of SS materials. A diagram is given of the quality control procedure for the Hallam core loading of enriched uranium material. (P.C.H.)

3268 (TID-7615(p.14-21)) THE DEFINITION AND HISTORY OF SAFEGUARDS. J. H. Herring (Division of International Affairs, AEC).

The historical development of the Atoms for Peace Program, the program objectives, accomplishment of objectives, and administration of safeguards, and a brief history of the International Atomic Energy Agency, including its problems and objectives, are discussed. (P.C.H.)

3269 (TID-7615(p.22-56)) FINAL REPORT OF THE NUCLEAR MATERIALS CONTROL SYSTEM. D. L. Drukey (Ramo-Wooldridge. Div. of Thompson Ramo Wooldridge Inc., Canoga Park, Calif.).

The results of the Ramo-Wooldridge Division's analyses on operations in a typical nuclear complex, such as might be implemented overseas, and methods for utilizing the results of measurements made in that complex to insure that nuclear materials are not lost or diverted are presented. The results may be extended to a variety of nuclear facilities in addition to the specific complex under study. The scheme used as a model consists of nine reactors, a chemical processing plant, and fuel fabrication facilities to support the reactors. (P.C.H.)

3270 (TID-7615(p.57-64)) MEASUREMENT OF BULK VOLUMES IN PROCESS TANKS. D. W. Hoba (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). (HW-SA-2173)

Procedures, equipment, precautions, and statistical techniques necessary for the quantitative determination of bulk volumes are described. Calibration methods are included for both geometrically linear and for nonlinear tanks. Accuracy and precision estimates are provided for a tank calibrated by the weight increment method and the data statistically analyzed by cumulative techniques. (auth)

3271 (TID-7615(p.65-77)) CURRENT EXPERIENCE AND THINKING ON THE PLUTONIUM RATIO METHOD OF RECEIPT MEASUREMENT. W. H. Johnson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). (HW-SA-2172)

The ratio method for determining the receipt measurement of plutonium is evaluated. An actual experience with the ratio method at Hanford is also discussed. It provided an accurate plutonium input measurement to the separations plants at a reasonable cost. Advantages of the ratio method such as relative independence from sampling and waste uncertainties and cost are also given. (P.C.H.)

3272 (TID-7615(p.78-89)) SIMULTANEOUS MASS SPECTROMETRIC DETERMINATION OF PLUTONIUM AND URANIUM BY THE ISOTOPE DILUTION TECHNIQUE: APPLICATION TO POWER REACTOR FUEL DISSOLVER SAMPLES. William J. Maeck, Maxine E. Kussy, Thomas D. Morgan, James E. Rein (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho) and Matthew T. Laug (Argonne National Lab., Idaho Falls, Idaho).

A rapid separation method, based on a batch, liquid-liquid extraction system, which provides a uranium–plutonium separated fraction free of fission products and diverse ions, including americium and curium, and with a controllable uranium to plutonium ratio such that both elements are determinable with a single loading of the filament, is described. Using uranium-233 and plutonium-242 as added isotopes, a series of simulated, typical fuel dissolver solutions were analyzed for uranium and plutonium concentration and isotopic distribution with precisions of better than 1 relative percent standard deviation. An increase to 2% can be expected under routine laboratory operation with radioactive samples which require remote handling. (P.C.H.)

3273 (TID-7615(p.90-101)) RADIOMETRIC ASSAY BY PRECISION CALORIMETRY. W. L. Pillinger (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.).

The usefulness of precision calorimetry in the nondestructive assay of radioactive materials is discussed. A local application is described in which isothermal calorimetry is employed to determine tritium content of gases. A recent precise determination of the heat output of tritium, 0.3240 ± 0.0009 watt per gram, is also discussed. (auth)

3274 (TID-7615(p.102-19)) FABRICATION OF PLUTONIUM FAST REACTOR FUELS. A. B. Shuck (Argonne National Lab., Ill.).

The fabrication of plutonium reactor fuels at Argonne is discussed, and the facilities for such work are diagrammed and discussed. Remote fabrication of the fuel elements, developed for the EBR-II, along with the cost of the constructed pilot plant are described. Developmental equipment was also designed. The remote-controlled refabrication equipment to be used in the EBR-II Fuel Cycle Facility was designed on the basis of experience gained in Core I production. Descriptions of the equipment are given. (P.C.H.)

3275 (TID-7615(p.120-4)) PANEL DISCUSSION: "THE APPLICATION OF DATA PROCESSING TO SS MATERIALS MANAGEMENT RECORDS AND INVENTORIES."

The role of machine accounting systems in management records and inventories in weapons manufacture and storage is discussed. (P.C.H.)

3276 (TID-7615(p.125-7)) APPLICATION OF IBM EQUIPMENT IN PREPARING MONTHLY ACCOUNTABILITY REPORTS. Robert Rusche (National Lead Co. of Ohio, Cincinnati).

Discussion is given on the types of equipment in use at the present time, the procedure for documents, processing of cards, the types of reports generated, and future plans at the National Lead Company. The advantages of using IBM equipment are pointed out. (P.C.H.)

3277 (TID-7615(p.128-9)) THE APPLICATION OF DATA PROCESSING TO SS MATERIALS MANAGEMENT RECORDS AND INVENTORIES. Franklynn V. Cotner (Albuquerque Operations Office, AEC).

Specific problems encountered with manual SS materials management records and inventories and the proposed or actual solutions through the use of automatic or electronic data processing systems are discussed. (auth)

3278 (JPRS-9706) LABOR HYGIENE AND OCCUPATIONAL DISEASES. Translation of Gigiena Truda i Professional. Zabolevaniya, 5: No. 4, 3-65(Apr. 1961). 99p.

Included are 14 articles concerned with labor hygiene and occupational diseases, a book review of Toxicology and the Pharmacobiodynamics of Organic Phosphorus Compounds, and a review of the meeting of The Third International Congress on Medical Radioelectronics. Separate abstracts were prepared for the 14 articles. (B.O.G.)

3279 (JPRS-9706(p.1-7)) PROBLEMS OF CURRENT IMPORTANCE IN THE STUDY OF THE RADIATION FACTOR IN LABOR HYGIENE. A. S. Arkhipov. (Translation).

Problems of the hygienic normalization of elements of the radiation factor encountered in the use of radiation sources in industry are discussed for: radiation safety in the operation of atomic power stations, particle accelerators, and cyclotrons; carcinogenic effects of radioactive substances

entering the body; mining of radioactive materials; radiation safety in γ-radiomateriology and γ-radiographic flaw detection in machine production operations; and the use of radioisotopes in agriculture, ferrous metallurgy, and the textile industry. Measures suggested to reduce the radiation factors include mechanization and automation of industry, the use of hermetically sealed apparatus, remote control, and efficient planning of industrial protection. (B.O.G.)

3280 (JPRS-9706(p.8-15)) MAXIMUM PERMISSIBLE LEVELS OF IONIZING RADIATION ADOPTED IN THE USSR IN 1960 (PDU-1960). N. G. Gusev. (Translation).

A description is given of the maximum permissible limits (PDU-1960) including a discussion of the sources utilized in creating the limits, in terms of the original maximum permissible doses (PDD), external levels of ionizing radiation, changes and additions in PDU-1960 compared with recommendations of the International Commission on Radiological Protection for the maximum permissible concentration of radioactive substances in water and air, and methods of calculation which afforded these changes. (B.O.G.)

3281 (JPRS-9706(p.16-20)) SOME PROBLEMS OF THE BIOLOGICAL SUBSTANTIATION OF MAXIMUM PERMISSIBLE CONCENTRATIONS OF RADIOACTIVE SUBSTANCES. E. B. Kurlyandskaya. (Translation).

A discussion is given of the methods and principles used in the biological substantiation of the maximum permissible concentration of radioactive substances and the maximum permissible dose for ionizing radiation for man. A survey shows how the maximum permissible dose has decreased from 0.1 to 0.2 r/day in 1921 and 0.2 r/day in 1931 to 0.3 r/week in 1950 and 0.1 r/week in 1960. (B.O.G.)

3282 (JPRS-9706(p.21-7)) SOME PROBLEMS OF RADIATION HYGIENE IN THE MINING AND CONCENTRATING OF ORES CONTAINING ADMIXTURES OF NATURAL RADIOACTIVE SUBSTANCES. L. T. Elovskaya (Yelovskaya). (Translation).

Radiation monitoring techniques were used to evaluate the radiation factor present in the mining and concentrating of nonferrous and rare metal concentrates containing free silica and admixtures of thorium and uranium. The contamination of the air medium in the mine and concentration plant creates the possibility for entrance of the radioactive substance into the body. The factor of external radiation was considered of no essential significance at the places studied. Recommendations were made of health measures for use in the mine and the concentration plant. (B.O.G.)

3283 (JPRS-9706(p.28-34)) HYGIENIC CHARACTERIZATION OF SOME CASES OF APPLICATION OF RADIOACTIVE ISOTOPES IN BLAST-FURNACE PLANTS. N. I. Volkova. (Translation).

A discussion is given of the use of Co^{60} for an evaluation of the erosion of the lining of blast furnaces, and the use of P^{32}, Co^{60}, and Sb^{124} to study the movement of charge materials in the blast furnace. It is shown that with the observation of hygienic measures; for example, use of short-lived isotopes, accomplishment of work operations in sequences of several operators, the use of remote-control instrumentation, and preliminary calculations of the radioactive content in the products, the use of radioisotopes in blast furnace production can be safe. (B.O.G.)

3284 (JPRS-9706(p.35-9)) MATERIALS ON THE HYGIENIC CHARACTERIZATION OF LABOR CONDITIONS IN WORKING ON THE 680 MeV SYNCHROCYCLOTRON. V. V. Volkovitskaya. (Translation).

A survey is given of studies of the occurrence of neutrons, γ rays, electromagnetic waves, ozone, and nitrogen oxides in the air of the working areas during the operation of the 680-Mev synchrocyclotron. Dosimetry studies show that the radiation levels and the contamination of air by radioactive aerosols are less than the maximum permissible levels. (B.O.G.)

3285 (JPRS-9706(p.40-9)) SPECIAL GARMENTS MADE OF SYNTHETIC FIBERS FOR WORKING WITH RADIOACTIVE SUBSTANCES. S. M. Gorodinskii (Gorodinskiy), Z. E. (Ye.) Panfilova, and N. A. Promptova. (Translation).

Fabrics of synthetic fibers evaluated for use as protective clothing for personnel working with radioactive materials include; lavsan (polyterephthalate), fluorlon (copolymer of tetrafluoroethylene and vinylidine fluoride), chlorene (perchlorovinyl), nitron (polyacrylonitrile), and capron (polycaprolactam). Properties of the fibers are minimum sorption of radioactive substances, practically complete decontamination by washing, improved physicomechanical indices assuring reliability and convenience of operation, resistance to aggressive agents acting on the garment during wearing and deactivation, adequate permeability to air assuring heat regulation under ordinary conditions, and absence of unpleasant odors or skin irritation after prolonged contact. Data characterizing the physicomechanical and chemical properties of the synthetic fibers are compared with those of wool and cotton. The lavsan fabric was found to wear longer than cotton fabrics, and was recommended to replace cotton garments for personnel handling radioactive materials. (B.O.G.)

3286 (JPRS-9706(p.50-5)) THE USE OF PECTIN AS A PROPHYLACTIC AGENT FOR STRONTIUM INTOXICATION. A. D. Bezzubov and A. I. Khatina. (Translation).

The reactions between sunflower and beet pectins with $Sr(NO_3)_2$ and $SrCl_2 \cdot 6H_2O$ in aqueous solutions at 1.94 to 7.70 pH were studied to determine their effectiveness as strontium detoxicants. The ability of the pectin to bind strontium was found to increase with increases in pH. At the pH of gastric juice the reactive power of pectin decreases and the bound strontium is 28.49 and 26.38% for sunflower and beet pectins, respectively. The pectins are most active at 7.6 pH; where the bound strontium is 71.71% for sunflower and 63.92% for beet pectin. (B.O.G.)

3287 (JPRS-9706(p.56-62)) THE INFLUENCE OF PECTIN ON THE ABSORPTION OF RADIOACTIVE STRONTIUM FROM THE GASTROINTESTINAL TRACT IN EXPERIMENTS. A. A. Rubanovskaya. (Translation).

The influence of the oral administration of pectin on the sorption of strontium-90 in the gastrointestinal tracts of rats was investigated. Sunflower pectins were found to bind the Sr-90 in the tract and to reduce the sorption and deposition of the isotope in the skeleton. The pectin was found less effective for old animals, which is possibly associated with the longer retention of food masses in the intestine. (B.O.G.)

3288 (JPRS-9706(p.63-70)) EXPERIMENTAL INVESTIGATIONS OF THE INFLUENCE OF PECTIN ON THE EXCRETION OF COBALT FROM THE BODY. S. S. Lipinskii (Lipinski). (Translation).

The results indicate that the pectin is a complex-forming substance with cobalt, which binds cobalt in vitro and contributes to the acceleration and increase in the excretion of cobalt from the body. The effectiveness of complex-formation is high only when this process occurs under conditions where the metal is included in metabolism; i.e., where the metal and the complex do not have immediate contact, and for the purpose of forming a complex one of

them must overcome the tissue barriers of the organism. Calculations of the half excretion period of cobalt resulted in 25 hr for control animals and 20 hr for the animals to which pectin was fed. (B.O.G.)

3289 (JPRS-9706(p.71-5)) PROBLEMS OF LABOR HYGIENE IN THE SMELTING OF ORES CONTAINING RADIOACTIVE ADMIXTURES. L. N. Balanina, S. A. Klyugin, and V. N. Petiforov. (Translation).

Investigations were made of the preparation of charge and smelting as processes for reprocessing raw materials containing thorium as an admixture. The processes are associated with the production of dust, which is contaminated. Needs are expressed for maximum shelter at the place of dust production, and a facility for the decontamination of the ejected air. Metals obtained as a result of the smelting are not radioactive, but the slag is. Dust elimination should be provided for the process of unloading, transporting, and storing the slag. (B.O.G.)

3290 (JPRS-9706(p.76-8)) SANITARY HYGIENIC LABOR CONDITIONS AND THE STATE OF HEALTH OF WORKERS IN THE BATHHOUSES OF NATURAL RADIOACTIVE SPRINGS OF TSKHALTUBO. V. A. Khubutiya, M. E. (Ye.) Kurashvili, E. M. Kakauridze, A. A. Khavtasi, and T. A. Kakuliya. (Translation).

The investigation revealed an abundance of complaints of a vegetative nervous system-asthenic character: dizziness, headaches, sluggishness, rapid fatigability, sleepiness during working hours, and insomnia at night. These phenomena were found to increase during working hours, and decrease gradually afterwards; and were considered to be the effect of small doses of radon in combination with high temperatures and humidities. Biochemical studies of the blood of the workers indicated increases in the nonprotein nitrogen, and decreases in chlorides and sodium. (B.O.G.)

3291 (JPRS-9706(p.79-80)) FLAW DETECTION IN WELDS AND METAL ARTICLES. R. S. Belova and E. (Ye.) L. Sheftel. (Translation).

Working conditions were investigated during the gamma spectroscopy of welds in gas lines, oil tanks, and metal articles using Co^{60} preparations and a stationary GUP-Co-0.5-1 apparatus. Improper uses of the isotope preparations resulted in exceeding the radiation norms for examining the welds. The radiation norms were not exceeded in the use of stationary GUP-Co-0.5-1 apparatuses and while using portable apparatus where the need of long-distance transportation of the preparations was eliminated. (B.O.G.)

3292 (JPRS-9706(p.81-6)) THE PROBLEM OF DEACTIVATION OF DIFFERENT SYNTHETIC CONSTRUCTION MATERIALS CONTAMINATED WITH RADIOACTIVE IRON. N. A. Pavlovskaya and E. (Ye.) S. Skripchenko. (Translation).

The removal of $Fe^{59}Cl_3$ from linoleum and plastic surfaces was evaluated using such wetting agents as, Na_3PO_4, HCl, hexametaphosphate, kerosene, laundry soaps, citric acid, NH_4CNS mixtures with Na_2CO_3 and hexametaphosphate, and kerosene mixtures with Na_3PO_4. The results of the evaluations are tabulated and show that the degree of residual activity on the materials is not a stable magnitude for a wetting agent from one material to another or the same material, but is dependent on the amount of original contamination. (B.O.G.)

3293 (JPRS-10599) REGULATIONS FOR THE TRANSPORTATION OF RADIOACTIVE MATERIALS. Translated from Pravila Perevozki Radioaktivnykh Veshchestv (a publication of the State Atomic Energy Publishing House, 1961). 71p.

The regulations were developed in consonance with the requirements of the sanitary regulations covering work with radioactive materials and sources of ionizing radiation taking into account the international recommendations of 1960. The regulations are mandatory for all concerned with the transportation, storage, and use of radioactive materials. (B.O.G.)

3294 (NP-tr-818) MEDICAL SUPERVISION OF PERSONS OCCUPATIONALLY EXPOSED TO RADIATION. I. Danczkay and H.-J. Melching. Translated by D. Cook-Radmore (U.K.A.E.A. Atomic Energy Research Establishment; Harwell, Berks, Eng.). from Atomkernenergie, 6: 177-22(1961). 20p.

Requirements are surveyed for the medical examination of personnel occupationally exposed to radiation, which are laid down by various countries and establishments, stressing the points on which the regulations differ. Problems are discussed which arise from an excessive or insufficient individual adaptation of legislative measures on the nature and extent of medical examination. (B.O.G.)

3295 SAMPLING FLOWING LIQUID WASTES FOR RADIOACTIVITY MONITORING. John M. Ruddy (Brookhaven National Lab., Upton, N. Y.). Air Conditioning, Heating, and Ventilating, 57: No. 9, 63-7(1960).

The purpose, methods, equipment, and design criteria are described for sampling flows varying from small and intermittent (the effluent of a laboratory building) to large and continuous (sewage disposal plant). Data are given for quantities of liquid wastes which might be expected from various types of laboratory buildings. (auth)

3296 FALLOUT. A. van der Linde and R. Braams. Chem. Weekblad, 57: 501-5(1961). [(In Dutch)]

The chemical mechanism of radioactive fall-out from nuclear weapons' tests is outlined. Two types of nuclear explosion reactions are mentioned: fission reactions and fusion reactions. The effects of the explosion and the formed fission products are described. The history of a radioactive fall-out particle, from formation after the detonation in the atmosphere and the stratosphere to incorporation into the human body, is briefly described. (NPO)

3297 ANALYSIS OF AIRBORNE RADIOACTIVITY IN JAPAN DUE TO NUCLEAR TESTINGS. Ryozo Aoki (Hitachi Central Lab., Tokyo). J. At. Energ. Soc. Japan, 3: 711-16(Sept. 1961). (In English)

The level of surface airborne radioactivity in Tokyo, Japan, during April 1959 to June 1961 was investigated. In spring 1961 and 1960, a maximum peak of activity was detected with an increase of 4 to 5 times of the background. The half elimination time of the storage above tropopause is estimated about 300 to 400 days. From the γ-spectrum of the sample collected in Mar. 1959, $Ce^{144}-Pr^{144}$, $Ru^{106}-Rh^{106}$, $Cs^{137}-Ba^{137m}$ were estimated. From the sample collected during Feb. to July 1960, $Ce^{144}-Pr^{144}$, $Ru^{106}-Rh^{106}$, Nb^{95}, Ru^{103} were detected, which might be ascribed to the French nuclear test. The cascade-sum effect of well-type scintillator was taken into consideration in estimating the crystal peak efficiency for γ-spectrum assaying. (auth)

3298 LLOYD'S REGISTER OF SHIPPING RULES AND NUCLEAR SHIPS. J. M. Murray and H. N. Pemberton. J. Joint Panel Nuclear Marine Propulsion, 5: 47-88(Oct. 1961).

Lloyd's Register of Shipping's "Provisional Rules for Nuclear Ships" is discussed, and these rules are related to hull design, materials of construction, and longitudinal strength. The requirements for collision and grounding protection are explained and the design criteria to be

adopted in order to meet the rapid decelerations consequent upon collision and grounding, are stated. In addition, the basic considerations to be examined for the design of containment vessel support structure are discussed. In order to demonstrate the hull requirements a design for a nuclear powered passenger ship is outlined. Rules relating to reactor and main machinery installation are discussed, and some of the safety requirements are examined in relation to a suggested reactor layout for the passenger ship. A reactor vessel and containment vessel design is proposed in order to demonstrate the rules for pressure components, and an electrical distribution system suitable for installation in the ship is outlined. A brief survey of the specific requirements of the reactor core and fuel assemblies, decay heat removal system, reactor control instrumentation, is offered and an examination of the problems associated with defueling and effluent disposal, with particular emphasis on the passenger ship installation is given. (auth)

3299 PRINCIPAL PROVISIONS, REQUIREMENTS AND STANDARDS OF THE NEW REGULATIONS FOR TRANSPORTATION OF RADIOACTIVE SUBSTANCES. P. I. Moiseitsev. Med. Radiol., 6: No. 9, 3-5(Sept. 1961). (In Russian)

3300 MAINTENANCE PROBLEMS INCREASE—WHEN WORKING AROUND RADIOACTIVE EQUIPMENT. Max G. Petersen (General Electric Co., Richland, Wash.). Mill & Factory, 67: No. 2, 108-11(Aug. 1960).

Maintenance practices used at the Hanford Atomic Products Operation are described. Most maintenance work in the plutonium production plant is conventional and well recognized. However, due to radiation and specialized equipment, unusual problems arise. To meet each problem in an orderly manner, a block system is used for work assignments and selected craftsmen are trained to be analytical and to think for themselves. Thus, on-the-spot maintenance is provided and equipment failure is kept at a minimum. (N.W.R.)

3301 HEALTH PHYSICS AT SL-1. John R. Horan and C. Wayne Bills (U. S. Atomic Energy Commission, Idaho Falls, Idaho). Nucleonics, 19: No. 12, 43-6(Dec. 1961).

The health physics experience obtained in the accident at the Army Reactor (SL-1) site at Idaho Falls is evaluated. The information suggests that there must be better methods for handling radioactive casualties and there must be detectors with a larger range. (T.R.H.)

3302 SAFETY ASPECT OF MARINE NUCLEAR PROPULSION. Jozef M. Pawlikiewicz (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 6: 423-32(1961). (In Polish)

A theoretical case of nuclear contamination of sea water as a result of reactor core release is discussed, and a hypothetical problem of a nuclear accident in the ship's power plant is analyzed. Safety means for preventing a nuclear accident in the power plant are given. Conclusions are drawn as to the safety problems involved for a marine nuclear propulsion plant. (N.W.R.)

3303 NUCLEAR SAFETY. Technical Progress Review, Vol. 3, No. 1. W. B. Cottrell, ed. (Oak Ridge National Lab., Tenn.). Sept. 1961. 107p. $0.55(GPO) (Domestic), $0.70(GPO) (Foreign).

Developments in the field of nuclear safety are reviewed. General safety criteria, accident analysis, instrumentation and control, plant safety features, consequences of activity release, and current events are discussed. (M.C.G.)

3304 IMPROVEMENTS IN OR RELATING TO PROTECTIVE OVERSHOES. George William Clare (to United Kingdom Atomic Energy Authority). British Patent 883,867. Dec. 6, 1961.

An inexpensive protective paper overshoe which may be burned is described for use in contaminated areas. The overshoe comprises an upper portion of pre-crimped paper, a sole portion of card or thick paper, and an elastic ankle aperture. (D.L.C.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

Refer also to abstract 3283

3305 (BMI-1553) USE OF INTRINSIC RADIOTRACERS FOR INDUSTRIAL PROCESS CONTROL. James L. McFarling, Peter Gluck, John F. Kircher, and Duane N. Sunderman (Battelle Memorial Inst., Columbus, Ohio). Nov. 9, 1961. Contract W-7405-eng-92. 57p.

A survey and a process evaluation showed that intrinsic radiotracer process control potentially could be applied to a number of economically important industrial processes. Demonstration of the proof of principles of the process-control concept was carried out by constructing and operating a laboratory model to simulate the use of intrinsic radiotracers in three applications. It was shown experimentally that the use of Fe^{59} as an intrinsic tracer in the iron-romoval process results in greatly improved accuracy in the determination of residual iron. A continuous readout of the impurity iron concentration was obtained without radioactive contamination of the product. Experimental study of Mn^{54} as intrinsic radiotracer demonstrated the technical feasibility of this method for helping to remove low-concentration impurities from process streams. Experimental study also showed that Cd^{115m} could be used to give an accurate, nearly instantaneous readout of the cadmium concentration during a zinc-electrolyte purification step. (auth)

3306 (MND-P-2581-I) ISOTOPIC POWER SOURCES. A COMPENDIUM. Property and Processes Review. E. H. Smith, comp. (Martin Co. Nuclear Div., Baltimore). June 1961. Contract AT(30-3)-217. 342p.

A selective bibliography was compiled containing 2063 references to report and published literature on isotopes usable as power sources. The source was Nuclear Science Abstracts Volumes 1 through 14 (1948 to 1960). Nuclear, physical, and chemical properties and separation processes were emphasized, biological aspects were excluded. The isotopes covered are Sr^{90}, Cs^{137}, Ce^{144}, Pm^{147}, Po^{210}, Ra^{228}, Ac^{227}, Th^{228}, U^{232}, Np^{237}, Pu^{238}, Pu^{239}, Pu^{241}, Am^{241}, Cm^{242}, Cm^{243}, and Cm^{244}. The thoroughness of the search was greatest for the transuranium isotopes, Pm^{147}, Po^{210}, and Ac^{227} but was deliberately restricted to the most pertinent information about U^{232}, Th^{228}, and the fission product elements. The bibliography is arranged according to elements, modified by the number of references included. (auth)

3307 (AEC-tr-4497) TRANSACTIONS OF THE ALL-UNION SCIENTIFIC TECHNICAL CONFERENCE ON THE USE OF RADIOACTIVE AND STABLE ISOTOPES AND RADIATIONS IN THE NATIONAL ECONOMY AND IN SCIENCE, APRIL 4-12, 1957. ISOTOPES AND RADIATION IN CHEMISTRY. Translation of Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim. 480p.

Papers presented at the All-Union Scientific Conference on the Use of Radioactive and Stable Isotopes and Radiation in the National Economy and Sciences are given. The 51 papers are grouped under the following headings: kinetics and mechanism of chemical reactions, radiation chemistry, analytical chemistry and physico-chemical analysis, radiochemistry, and chemical methods of preparation of labeled compounds. Separate abstracts were prepared for each paper. (M.C.G.)

3308 (AEC-tr-4497(p.1-8)) INVESTIGATION OF THE INTERACTION OF ATOMS BY THE METHOD OF DEUTERIUM EXCHANGE. (PHENOL AND ITS ETHERS AND AROMATIC AMINES). A. I. Shatenshtein and A. V. Vedeneev. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.7-12.

The method of isotopic hydrogen exchange was applied to the study of the interaction of atoms in the molecules of organic compounds. Phenol and its ethers, when dissolved in liquid DBr at room temperature immediately exchanged 3 hydrogen atoms in every ring and there was no further exchange even at long duration of the experiment. The hydrogen exchange in aromatic amines was also studied. Ortho- and para-hydrogens were exchanged in a molecule of triphenylamine at room temperature in less than 5 minutes. The meta-atoms were not exchanged after 200 hr. In dimethylaniline there was no hydrogen exchange even after 1000 hr. It was concluded that the difference in behavior of nitrogen- and oxygen-containing compounds is explained by the different coordinating capacity and different proton affinity of N and O atoms in the compounds in question. In the hydrogen exchange between anisole and a base, as well as in the hydrogen exchange in a phenoxide ion, the meta-atoms had no preferential activity, as was expected if the π, p-conjugation effect was a determining factor, as it is in hydrogen exchange with an acid. (M.C.G.)

3309 (AEC-tr-4497(p.9-16)) INVESTIGATION OF SOME HETEROLYTIC REACTIONS BY THE HYDROGEN EXCHANGE METHOD. D. N. Kursanov, V. N. Setkina, Z. N. Parnes, and E. V. Bykova. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.13-19.

Attempts were made to find a relation between the hydrogen exchange accompanying some liquid-phase heterolytic reactions and the mechanism of these reactions. The hydrogen exchange was studied in two heterolytic reactions of alkyl iodides: hydrolysis and reactions involving substitution of one iodine atom for another. Data indicated that the reaction of hydriodic acid with tertiary alkyl iodides passes through the intermediate stage of carbonium and ion formation, while in the case of secondary and primary alkyl iodides this stage is absent. Studies of the dimerization of 1-methylcyclohex-1-ene with deuteriophosphoric acid showed that the reaction takes place with the formation of intermediate carbonium ions. The rearrangement of pinacol into pinacolone under the influence of D_2SO_4 was investigated and it was found that the pinacolone formed contained only 3 exchanged hydrogen atoms. (M.C.G.)

3310 (AEC-tr-4497(p.17-29)) ISOTOPIC EXCHANGE OF OXYGEN, NITROGEN AND SULFUR IN SOLUTIONS AND ITS MECHANISM. A. I. Brodskii, N. A. Vysotskaya, I. I. Kukhtenko, G. P. Miklukhin, L. L. Strizhak, and L. V. Sulima. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluch-

enii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.20-8.

On the basis of study of the oxygen exchange in mineral acids and salts, an exchange mechanism was developed with the intermediate addition of water and formation of ortho compounds. According to this mechanism the rate of exchange and the actual possibility of exchange depend on the electrophilicity of the x atom in a given bond and on its ability to increase its coordination number by the addition of water. The nitrogen exchange between liquid ammonia enriched with N^{15} and the compounds dissolved in it was studied. The exchange reaction corresponded to the mechanism of bimolecular nucleophilic substitution in which the amino group formed with ammonia displaces the amino group of the organic compound with a simultaneous proton transfer. Sulfur exchange was studied to show the dependence of the rate of exchange on the structure of the compounds. (M.C.G.)

3311 (AEC-tr-4497(p.30-6)) APPLICATION OF RADIOACTIVE MERCURY Hg^{203} IN THE STUDY OF THE SUBSTITUTION REACTION MECHANISM AT THE CARBON ATOM. O. A. Reutov, G. M. Ostapchuk, Yan-tsei Wu (U), T. A. Smolina, and P. Knol'. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.29-34.

Preliminary results of the study of isotopic exchange in organomercuric compounds of the aromatic series are presented. The exchange increased with temperature and in the presence of excess radioactive metallic mercury. Peroxides present in dioxane not treated with alkali also increased the isotopic exchange reaction. (M.C.G.)

3312 (AEC-tr-4497(p.37-45)) THE RATE OF DECOMPOSITION OF ACETYL RADICAL AND ITS REACTIONS WITH FREE OXYGEN. M. B. Neiman and N. K. Serdyuk. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.35-41.

The kinetic method of labeled atoms was used to determine the conversions of acetyl radical on oxidation of various hydrocarbons. The rate of formation of carbon oxides was determined by graphic differentiation of the kinetic curves for the CO and CO_2 concentrations. (M.C.G.)

3313 (AEC-tr-4497(p.46-58)) PLANAR CHAINS AND ACTIVE INTERMEDIATE FORMS OF HETEROGENEOUS CATALYSIS AS INDICATED BY ISOTOPIC DATA. S. Z. Roginskii. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.42-50.

The problem of chains in heterogeneous catalysis was studied in an attempt to detect the planar chains with the use of isotopes. Detection of the chains formed by propagation by the distribution of radioactive carbon, chains formed by destruction during oxidation of hydrocarbons, substitution chains formed during deuterium exchange, active intermediate forms of the isotopic exchange catalysis, and chains formed by transfer are discussed. The existence of chains formed by propagation, destruction, and substitution was established. The existence of chains formed by transfer was not proved, but several cases can be explained along these lines. (M.C.G.)

3314 (AEC-tr-4497(p.59-65)) STUDY OF THE MECHANISM OF CONSECUTIVE REACTIONS OF THE BUTANE-BUTYLENE-DIVINYL SYSTEM EMPLOYING RADIOACTIVE CARBON C^{14}. A. A. Balandin, O. K. Bogdanova, G. V. Isagulyants, M. B. Neiman, and E. I. Popov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.52-7.

C^{14}-labeled butane was used to study the dehydrogenation of butane-butylene mixtures. It was concluded that the formation of divinyl from butane passes not only through the stage of butylene formation but also through the stage of desorption of butylene from the catalyst's surface. (M.C.G.)

3315 (AEC-tr-4497(p.66-75)) INTERMEDIATE COMPOUNDS IN SYNTHESIS OF HYDROCARBONS AND OXYGEN-CONTAINING COMPOUNDS FROM CO AND H_2 OVER IRON CATALYSTS. Yu. B. Kryukov. A. N. Bashkirov, V. K. Butyugin, L. G. Liberov, and N. D. Stepanova. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.58-65.

An attempt was made to follow the conversion of n-butyl alcohol under actual conditions of synthesis over fused iron catalysts in order to determine if in the synthesis of hydrocarbons either an alcohol or some surface complex based on alcohol is the intermediate. The alcohol was labeled with C^{14}. It was found that alcohols cannot be considered to be intermediate products in the synthesis of hydrocarbons and oxygen containing compounds from CO and H_2 over fused iron catalysts. The data obtained supported the theory of the simultaneous formation of hydrocarbons and alcohols from CO and H_2 and the view that there is a common precursor to both. (M.C.G.)

3316 (AEC-tr-4497(p.76-87)) CHEMICAL CONVERSIONS OF ETHYLENE SUBJECTED TO PYROLYSIS. K. I. Karasev. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow. 1957 (1958). Izotopy i Izlucheniya v Khim., p.66-74.

Tracer techniques were used to study the extent of ethylene conversions from the ethane fraction subjected to pyrolysis. Ethylene labeled with C^{14} was added to carefully purified ethane and the activity of the components of the pyrolysis gases was used to determine what happened to the starting ethylene. It was found that ethylene when mixed with ethane is stable at high temperatures. Its stability decreased with an increase in its specific weight in the starting gas. It was established that the admixture of ethylene to ethane inhibited the conversion of the ethane. (M.C.G.)

3317 (AEC-tr-4497(p.88-98)) FORMATION OF VULCANIZATION NETWORKS AND THEIR CHANGE UNDER THERMO MECHANICAL ACTION AND FATIGUE. B. A. Dogadkin, Z. N. Tarasova, M. A. Vas'kovskaya, and M. Ya. Kaplunov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.75-82.

S^{35} was used to study the kinetics of the formation of vulcanization bonds and the changes in them brought about by thermochemical action and fatigue. A method was developed for determining the type of vulcanization networks by their capacity to undergo isotope exchange with elementary sulfur and sulfur-containing compounds. It was found that in the process of vulcanization the sulfur content varies according to a curve with a maximum coinciding in time with optimum vulcanization. The exchangeability of vulcanizates with elementary sulfur decreased monotonically. It was found that variation in the density of the vul-

canization network during fatigue is determined by the type of rubber and the nature of the vulcanization systems and depends on the course of the secondary processes of rearrangement of radicals formed in the breakdown of polymer chains and intermolecular bonds. (M.C.G.)

3318 (AEC-tr-4497(p.99-124)) PROSPECTS FOR THE USE OF NUCLEAR RADIATION IN CHEMISTRY. S. S. Medvedev. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.85-104.

The possibilities of using nuclear radiation for the realization of certain chemical processes are surveyed. Radioinduced polymerization and other chain processes, effects of nuclear radiation on polymers, and non-chain chemical processes are discussed and examples given. The most promising processes are polymerization, chlorination, and oxidation of organic compounds. (M.C.G.)

3319 (AEC-tr-4497(p.125-33)) EFFECT OF IONIZING RADIATION ON CONCENTRATED SOLUTIONS OF INORGANIC COMPOUNDS. P. I. Dolin and S. A. Brusentseva. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.106-12.

Radiochemical reactions in concentrated solutions of KBr were investigated. The dependence of the radiolysis yield of molecular products on the concentration of the dissolved substance was determined. Gamma rays were used to irradiate the KBr solutions. The following radiolysis products were investigated: mixture of hydrogen and oxygen, hydrogen peroxide, and free bromine. The yield of hydrogen increased with concentration for solutions with low concentrations of KBr, then became constant for a large interval, and starting with 0.1 M increased again. (M.C.G.)

3320 (AEC-tr-4497(p.134-44)) SENSITIZATION OF RADIOCHEMICAL PROCESSES IN AQUEOUS SOLUTIONS. II. REACTIONS OF MOLECULAR OXYGEN. M. A. Proskurin, B. D. Orekhov, E. V. Barelko, and A. I. Chernova. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.113-20.

Methods for the sensitization of the reactions taking place during radiolysis based on the assumption that excited molecules participate in these processes are discussed. The use of multiple valence ions, especially Fe^{3+}, for sensitization is described. The mechanism of the action of the catalyzing additions of multiple-valence ions on the radiolytic oxidation of organic compounds in aqueous solutions was studied. The radioinduced reaction of oxygen with organic compounds was also investigated using Fe^{2+} as a sensitizer. (M.C.G.)

3321 (AEC-tr-4497(p.145-59)) THE EFFECT OF α- AND γ-RAYS ON URANIUM SALT SOLUTIONS. M. Haissinsky. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.121-32.

The chemical conversions of uranium salts subjected to irradiation were studied. The majority of the experiments was carried out in 3N H_2SO_4, but the effects of acidity and the nature of the anion on the rate of auto-oxidation were also determined. Co^{60} gamma rays, x rays, and polonium alpha particles were used as sources of radiation. It was assumed that the oxidation of U^{4+} is carried out by OH radicals and that the reverse reduction of U^{6+} to U^{4+} can be disregarded. The oxidation product yield from alpha particles was considerably lower than from gamma and x rays. (M.C.G.)

3322 (AEC-tr-4497(p.160-1)) OXIDATION PROCESSES IN ORGANIC SYSTEMS INITIATED BY IONIZING RADIATION. N. A. Bakh and V. V. Saraeva. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.133-4.

The radiation oxidation of organic compounds with molecular oxygen is discussed. Radiation, photochemical, and non-catalytic thermal processes were compared. It was confirmed that the radicals formed in radiolysis have a higher energy than those produced by photolysis. (M.C.G.)

3323 (AEC-tr-4497(p.162-6)) RADIOLYSIS OF PENTANE ADSORBED ON SOLIDS. Augustine O. Allen and James M. Caffrey. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.135-8. (BNL-3149)

The radiolysis of pentane adsorbed on mineral solids was investigated. The hydrogen yield was determined as a function of weight concentration of pentane on solid powder. Silica and montmorillonite gave results that would be expected if the solid powder acted only as an inert diluent. Silica gel and aluminum oxide enhanced the hydrogen yield and ferric oxide and attapulgite decreased it. For methane yield the silica and attapulgite acted only as inert diluents. Silica gel and montmorillonite supressed methane formation and ferric oxide enhanced it. (M.C.G.)

3324 (AEC-tr-4497(p.167-8)) EFFECT OF NUCLEAR RADIATION ON POLYMERIC MATERIALS. V. L. Karpov, A. S. Kuz'minskii, and Yu. S. Lazurkin. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.139-40.

Radioinduced cross-linking of polymers is discussed. The dependence of the characteristics of the irradiated polymers on the intensity, dosage, and irradiation conditions was studied. The yield and composition of the gaseous products formed as a result of irradiation of some polymers were also investigated. (M.C.G.)

3325 (AEC-tr-4497(p.169-78)) DETERMINATION OF IMPURITIES IN SEMICONDUCTORS AND PURE METALS BY THE METHOD OF RADIOACTIVATION ANALYSIS. I. P. Alimarin and Yu. V. Yakovlev. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.143-9.

The principles of activation analysis are discussed. The use of activation analysis for the determination of very small amounts of impurities in almost completely pure materials is described. Special consideration was given to semiconductor materials. (M.C.G.)

3326 (AEC-tr-4497(p.179-88)) QUANTITATIVE DETERMINATION OF MICROIMPURITIES OF SOME ELEMENTS BY THE RADIOACTIVATION METHOD. O. E. Zvyagintsev and A. I. Kulak. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.150-7.

Methods were analyzed and developed for the determination of minute quantities of the following elements by ac-

tivation analysis: Au, Pt, Pd, and Ir in refined silver; Au, Pt, Pd, and Ir in cathode silver; Ni, Co, Cu, and Te in high purity antimony; and Co, Cu, Te, As, and Sb in preparative gold. (M.C.G.)

3327 (AEC-tr-4497(p.189-97)) PREPARATION OF RADIOACTIVE ISOTOPES WITHOUT CARRIERS. N. P. Rudenko. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.158-63.

Methods of separation of radioisotopes from liquid, solid, and gas phases are discussed. Adsorption, radiocolloid, distillation, chromatographic, extraction, and electrochemical methods of separation of the isotopes from liquid phases are described. The problems of separation without a carrier and of radiochemical purity are summarized. (M.C.G.)

3328 (AEC-tr-4497(p.198-203)) SOME PROBLEMS IN THE PREPARATION OF ISOTOPES WITHOUT CARRIERS BY THE SZILARD-CHALMERS REACTION. K. Svoboda. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.164-8.

Basic problems in the preparation of radioactive atoms with high specific activity by the Szilard-Chalmers reaction are discussed. Work was carried out to achieve a simultaneous decrease in the retention R and an increase in the specific activity S. Studies were carried out on the alkyl derivatives of iodine. It was found that a decrease in R with a simultaneous increase in S under conditions of extraction after irradiation can be attained in the following ways: use of neutron sources with small gamma background; irradiation at lower temperatures; and dilution of samples with suitable solvents. (M.C.G.)

3329 (AEC-tr-4497(p.204-5)) PREPARATION OF RADIOACTIVE ISOTOPES OF HIGH ACTIVITY. D. Shankar. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.169-70.

The preparation of radioisotopes by the (n,γ) reaction was studied. The effects of isothermal heating on the retention activity were determined. (M.C.G.)

3330 (AEC-tr-4497(p.206-14)) APPLICATION OF LABELLED ATOMS IN SPECTRAL ANALYSIS. E. E. (Ye.) Vainshtein. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.171-7.

Studies were made of the use of labeled atoms in spectral analysis. It was found that by using radioisotopes the true course of the volatilization curve can be determined for any given element. The use of radioisotopes in the spectral analysis of materials of high chemical purity is discussed. The analysis by the method of isotope dilution is described. (M.C.G.)

3331 (AEC-tr-4497(p.215-27)) RADIOMETRIC TITRATION OF RARE ELEMENTS. (DETERMINATION OF BERYLLIUM. ZIRCONIUM AND THALLIUM). I. M. Gibalo, I. A. Sirotina, and I. P. Alimarin. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.178-85.

A radiometric titration method was developed to determine beryllium and zirconium with phosphate, and thallium with iodide, chromate, phosphotungstic acid, and sodium tetraphenylboron. It was proved that the equivalence point of a radiometric titration can be calculated mathematically from two points. (M.C.G.)

3332 (AEC-tr-4497(p.228-37)) USE OF RADIOISOTOPES IN THE CHROMATOGRAPHIC SEPARATION OF MIXTURES OF ALKALI METALS AND RARE-EARTH ELEMENTS. M. M. Senyavin. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.186-92.

The use of radioisotopes in chromatography is discussed. The alkali metals and rare earth elements were taken as examples. Data obtained agreed with those of x-ray spectroscopy. Separations of these elements by the chromatographic method combined with isotope dilution gave good results. (M.C.G.)

3333 (AEC-tr-4497(p.238-42)) SEPARATION OF IRON AND COBALT BY ION-EXCHANGE CHROMATOGRAPHY. I. A. Korshunov, A. I. Subbotina, and V. I. Gnezdov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.193-6.

A study was made of the possibility of complete separation of Fe^{3+} and Co^{2+} by ion-exchange chromatography with the use of oxalic acid. Fe^{59} and Co^{60} were used as tracers. It was found that the presence of hydrogen peroxide in the oxalic acid solution used for the elution of the iron in the amount of 0.1% is sufficient for oxidation of reduced iron. It was found that during the use of 0.05 M oxalic acid with addition of hydrogen peroxide there is complete separation of iron from cobalt. (M.C.G.)

3334 (AEC-tr-4497(p.243-50)) USE OF RADIOACTIVE ISOTOPES FOR TESTING AND DEVELOPMENT OF THE ANALYSIS METHODS OF NON-FERROUS METALS AND METALLURGICAL DUST. M. I. Troitskaya, E. N. Artemova, and A. M. Zaraiskii. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.197-202.

Radioisotopes were used for the determination of the losses occurring during the separation of one element from several others which interfere with its determination. Methods were developed for the determination of zinc in nickel, cobalt, and cadmium. Grounds were provided for comparative evaluation of different separation methods. The accuracy of a given procedure used for the determination of an element was investigated using radioisotopes. (M.C.G.)

3335 (AEC-tr-4497(p.251-60)) APPLICATION OF RADIOACTIVE ISOTOPES FOR SOLVING THE PROBLEMS OF PURIFICATION OF INORGANIC SALTS BY CRYSTALLIZATION AND PRECIPITATION. G. I. Gorshtein and N. I. Silant'eva. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.203-10.

Crystallization and precipitation methods used for the purification of inorganic salts were studied using radioisotopes. Purification of salts from isomorphic and nonisomorphic impurities by crystallization from solutions and from admixtures by precipitation and coprecipitation were investigated. (M.C.G.)

3336 (AEC-tr-4497(p.261-9)) APPLICATION OF RADIOACTIVE ISOTOPES IN THE DEVELOPMENT OF PROCESSES FOR THE PREPARATION AND PURIFICA-

TION OF CHEMICAL REAGENTS. G. V. Abramova, G. I. Gorshtein, R. E. Gurevich, and A. M. Kheimets. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.211-17.

Methods and procedures for purification and preparation of chemical reagents were developed and evaluated using radioisotopes. The distribution of impurities during crystallization, precipitation, and coprecipitation processes was investigated using tracers. Radiometric methods were developed for phase control in production. (M.C.G.)

3337 (AEC-tr-4497(p.270-8)) DETERMINATION OF THE V. G. KHLOPIN DISTRIBUTION CONSTANT BY PARTIAL RECRYSTALLIZATION OF THE SOLID BASE. V. I. Grebenshchikova and R. V. Bryzgalova. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.218-23.

A method was developed for determining the V. G. Khlopin constants by partial recrystallization of the solid phase with application of radioactive tracers. The method had the same accuracy and was much more rapid than other methods. The method of partial recrystallization was also superior to that of the separation of the solid phase from supersaturated solutions, since it can be used for difficultly soluble salts at any temperature. (M.C.G.)

3338 (AEC-tr-4497(p.279-87)) COPRECIPITATION OF LEAD AND STRONTIUM ISOTOPES WITH CRYSTALS OF SODIUM CHLORIDE. M. S. Merkulova and I. V. Melikhov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.224-30.

To determine the causes of co-crystallization of bivalent metal ions with salts crystallized in the manner of sodium chloride, the following systems were studied: $NH_4I-PbI_2-H_2O$, $NaCl-PbCl_2-H_2O$, and $NaCl-SrCl_2-H_2O$. Pb^{210}, Pb^{212}, and Sr^{89} were used as tracers. The microcomponent distribution between the crystals and the salt solutions at a true equilibrium between liquid and solid phases was investigated. It was determined that the coprecipitation of bivalent metals with alkali metal halides cannot be considered as coprecipitation with the formation of internal adsorption systems. The crystallization coefficient decreased sharply with increasing concentration of the substance being distributed in solution. (M.C.G.)

3339 (AEC-tr-4497(p.288-96)) INVESTIGATION OF THE EFFECT OF VARIOUS FACTORS ON THE CRYSTALLIZATION COEFFICIENT OF RADIUM DURING ITS DISTRIBUTION BETWEEN THE MELT AND THE CRYSTALS OF LEAD CHLORIDE. V. R. Klokman, A. A. Mel'nikova, and V. A. Polyakov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.231-7.

The effects of temperature and the chemical nature of the second component of the binary system on the crystallization coefficient of radium on the example of radium distribution between the melt and the crystals of lead chloride in the binary systems $PbCl_2-NaCl$, $PbCl_2-CdCl_2$, and $PbCl_2-ZnCl_2$ were studied. The existence of polymorpic transformation of $PbCl_2$ at 420°C was proved with the aid of isomorphic co-crystallization. It was shown that in the systems a gradual decrease in the crystallization coefficient of radium takes place, which is explained by the decrease of the activity coefficients of micro- and macrocomponents in the melt due to formation of complexes. (M.C.G.)

3340 (AEC-tr-4497(p.297-307)) INVESTIGATION OF THE SUBLIMATION PROCESS OF TELLURIUM BY THE USE OF RADIOACTIVE TRACERS. A. S. Pashinkin, A. A. Men'kov, I. V. Korneeva, and A. V. Novoselova. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.238-45.

The saturation vapor pressure of solid tellurium was determined and the behavior of selenium, halogens, and iron impurities in the process of tellurium sublimation under vacuum were studied using tracer techniques. It was established that for practical purposes it is impossible to purify tellurium from small (1 to 0.025%) selenium impurities by vacuum sublimation. It was found that a single sublimation of tellurium containing bromine impurity reduces the content of the bromine 350- to 400-fold. It was determined that in the sublimation of tellurium containing an iron impurity, the latter practically does not sublimate. (M.C.G.)

3341 (AEC-tr-4497(p.308-19)) USE OF RADIOACTIVE SELENIUM FOR THE INVESTIGATION OF THE SULFUR–SELENIUM SYSTEM. O. V. Al'tshuler, G. N. Zviadadze, and D. M. Chizhikov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.246-54.

The liquid-vapor equilibrium in the S–Se system, the effect of sulfur on selenium adsorption by activated carbon, and the interaction of elemental selenium with the sulfides of heavy metals were studied. Se^{75} was used as a tracer. From the study of liquid-vapor equilibrium, it was concluded that sulfur and selenium form compounds, the stoichiometry of which is determined by the alloy composition and temperature. Adsorption of the selenium and sulfur decreased sharply with increasing temperature. The dependence of the selenium desorption on its concentration in the vapor-gas mixture during the adsorption process was determined. The study of the reaction equilibrium $Se + CdS \rightleftharpoons CdSe + S$ indicated that the elimination of the formed sulfur vapors from the reaction zone is a necessary condition for the preparation of pure selenide. (M.C.G.)

3342 (AEC-tr-4497(p.320-7)) MEASURING THE MOISTURE PERMEABILITY OF COATINGS MADE OF SYNTHETIC MATERIALS BY WATER LABELLED WITH TRITIUM. E. E. Finkel'. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.255-60.

A method was developed for measuring the moisture-permeability coefficient of synthetic films by the use of water labeled with tritium. The coefficient was determined by measuring the mass of water vapor diffused through a sample under the established stationary process per given length of time. Several different polymers were studied and the results were in agreement with previous data. (M.C.G.)

3343 (AEC-tr-4497(p.328-38)) EXTRACTION PROCESSES AND THEIR IMPORTANCE IN THE PREPARATION AND PURIFICATION OF RADIOACTIVE ISOTOPES. V. M. Vdovenko. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.263-70.

The general theoretical ideas concerning extraction and its use for the preparation and purification of radioisotopes are discussed. (M.C.G.)

3344 (AEC-tr-4497(p.339-52)) SOME PECULIARITIES IN THE BEHAVIOR OF MICROQUANTITIES OF RUTHENIUM DURING EXTRACTION. A. V. Nikolaev and N. M. Sinitsyn. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.271-81.

It was found that in the extraction of microquantities of Ru^{106} with TBP from HNO_3 solutions as a function of HNO_3 concentration, the curve passes through a maximum located at 0.5 to 0.8 N HNO_3. The presence of impurities in the TBP did not affect the distribution coefficient of ruthenium. Oxidizing agents increased the distribution coefficient of Ru^{106} in its extraction with TBP. Reducing agents decreased the distribution coefficient if they did not form nitric oxides with HNO_3. In the case of ageing of HNO_3 solutions containing Ru^{106}, the distribution coefficient of ruthenium, in its extraction with TBP, increased with time. (M.C.G.)

3345 (AEC-tr-4497(p.353-68)) ADSORPTION PHENOMENA AND THEIR ROLE IN RADIOCHEMICAL INVESTIGATIONS. I. E. Starik. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.282-93.

Investigations were made of the adsorption phenomena taking place on glass surfaces in contact with solutions of varying pH. The adsorption of Ra, Po, Ru, Tl, and UO_2 ions by glass and the adsorption of Zn^{95} by paper filters were studied. It was found that the adsorption was determined to a great extent by the states of the radioelements in solutions under various conditions. (M.C.G.)

3346 (AEC-tr-4497(p.369-81)) CHROMATOGRAPHIC SEPARATION OF PROMETHIUM FROM THE PRODUCTS OF URANIUM FISSION. A. K. Lavrukhina and F. I. Pavlotskaya. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.294-302.

The chemical and radioactive properties of promethium and their use to separate it from uranium fission products were studied. It was determined that by the use of ammonium lactate at pH 3.4 to 3.5 it is possible to isolate promethium in a radioactively pure state from the sum of rare earths obtained during U^{235} fission induced by thermal neutrons. It was established that in uranium fission induced by fast protons, 5 promethium isotopes are formed ranging in their mass numbers from 148 to 151. Data indicated that promethium can be separated in a radioactively pure state from neighboring elements. (M.C.G.)

3347 (AEC-tr-4497(p.382-8)) RADIOELECTROCHROMATOGRAPHIC ANALYSIS. P. V. Zimakov, A. G. Bykov, and I. A. Usacheva. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.303-8.

A radioelectrochromatographic method was developed for the determination of Ce, Y, Sr, Nd, Zr, Ru, and Cs in solutions of fission products. The position of a given radioisotope on the strip of chromatographic paper was established under definite conditions of electrophoresis. If the content of the isotope was more than 10%, the accuracy of the determination was approximately 10%. (M.C.G.)

3348 (AEC-tr-4497(p.389-99)) ELECTROCHEMICAL INVESTIGATION OF RADIOACTIVE ELEMENTS AS A MEANS OF STUDYING THEIR CHEMICAL PROPERTIES. D. M. Ziv and G. S. Sinitsyna. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., 309-17.

Results of potentiometric investigations of ultradilute solutions which became possible only through the use of radioactive elements are discussed. Methods of determining the valence and the normal potentials of polonium are described. The potentiometric method was used for the solubility determination of polonium hydroxide. The electrochemical potentials of silver were determined using Ag^{110} as the tracer. (M.C.G.)

3349 (AEC-tr-4497(p.400-10)) ELECTRODEPOSITION OF SMALL AMOUNTS OF URANIUM, NEPTUNIUM AND PLUTONIUM. A. G. Samartseva. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., 318-25.

A method was developed for the quantitative electrodeposition of Th, U, Pu, and Am from solutions of HNO_3, H_2SO_4, HCl, $HClO_4$, and $H_2C_2O_4$, at 10^{-2} M hydrogen-ion concentration in the electrolytes. It was found that the hydrogen-ion concentration and not the nature of the electrolyte anion is the determining factor in the electrodeposition of U, Np, and Pu. The dependence of the U, Np, and Pu yields on the cathodic current density and the electrolyte pH was investigated. (M.C.G.)

3350 (AEC-tr-4497(p.411-28)) INVESTIGATION OF SOME OXIDATION-REDUCTION REACTIONS OF AMERICIUM. A. A. Zaitsev, V. N. Kosyakov, A. G. Rykov, Yu. P. Sobolev, and G. N. Yakovlev. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.326-38.

Investigations were made of the oxidation-reduction reactions of americium in H_2SO_4 solutions. Am^{241} was used to study disproportionation and auto-reduction at 20 to 24°C. Disproportionation of Am(V) in moderately acid solutions was negligible, and practically only auto-reduction of Am(V) to Am(III) took place. The auto-reduction of Am(V) was determined by the formation rate of the reducing products of radiolysis of water and by the reaction rate of Am(V) with these products. The reaction rate depended on the concentration of Am(V). In strongly acid solutions, the disproportionation of Am(V) took place along with the auto-reduction of Am(VI). (M.C.G.)

3351 (AEC-tr-4497(p.429-37)) SYNTHESIS OF LABELLED ORGANIC COMPOUNDS AND THEIR RADIOCHEMICAL ANALYSIS. I. A. Korshunov and N. F. Novotorov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.341-7.

Based on CO_2, a number of organic compounds were synthesized containing C^{14} at different positions. Methods were developed for the quantitative radiochemical determination of labeled organic compounds, their carbon number, and their degree of purity. (M.C.G.)

3352 (AEC-tr-4497(p.438-45)) ACETYLENE-BASED SYNTHESIS OF ORGANIC COMPOUNDS LABELLED WITH C^{14}. V. P. Shishkov and T. N. Shashkina. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radio-

aktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.348-53.

The synthesis of organic compounds labeled with C^{14} from acetylene is discussed. Acetylene was prepared from barium carbide reactions with water. Benzene and its derivatives were prepared from acetylene by one method. The other branch of synthesis based on acetylene was represented by reactions yielding acetaldehyde, with subsequent conversion to acetic acid and its derivatives. (M.C.G.)

3353 (AEC-tr-4497(p.446-51)) SYNTHESIS OF PHENOL LABELLED WITH CARBON ISOTOPE C^{14} IN THE RING. T. V. Bichul', K. M. Berdichevskaya, and M. I. Miller. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.354-7.

The synthesis of phenol from aniline is discussed. A study of the individual stages of the synthesis indicated that the intermediate products obtained are sufficiently pure and suitable for use in the successive stages without additional purification and that some of them do not have to be isolated from the reaction mixture. (M.C.G.)

3354 (AEC-tr-4497(p.452-5)) SYNTHESIS OF ISOPRENE LABELLED WITH C^{14}. A. A. Korotkov and G. V. Rakova. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.358-60.

Steps in the preparation of C^{14}-labeled isoprene are described. Steps in the preparation of acetylene-C^{14}, dimethylethylcarbinol-C^{14}, dimethylvinylcarbinol-C^{14}, and isoprene-C^{14} are outlined. The yield of isoprene-C^{14} based on starting acetylene-C^{14} was about 50%. (M.C.G.)

3355 (AEC-tr-4497(p.456-60)) SYNTHESIS OF DIPHACIL LABELLED WITH RADIOACTIVE C^{14} IN THE ESTER GROUP AND IN THE ETHYL RADICAL. L. B. Dashkevich. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.361-3.

The preparation of the ester diethylaminoethyl diphenylacetate (diphacil) labeled with C^{14} in the ester group and in one of its ethyl radicals was carried out. Diphenylacetic acid labeled with C^{14} in its carboxyl group was prepared by sodium-organosynthesis. It was combined with diethylaminoethyl chloride labeled with C^{14} in one of the ethyl groups to produce diphacil. The radioactive yield based on diphenylacetic acid was 42%. (M.C.G.)

3356 (AEC-tr-4497(p.461-4)) SYNTHESIS OF ACETYLCHOLINE LABELLED WITH RADIOCARBON C^{14} IN ITS ESTER GROUP. L. B. Dashkevich and V. S. Karpinskii. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.364-6.

A method for preparing acetylcholine labeled with C^{14} in the ester group is described. The radioactive yield of acetylcholine based on the choline hydrochloride did not exceed 20 to 25%. (M.C.G.)

3357 (AEC-tr-4497(p.465-72)) INVESTIGATION OF ISOTOPE EXCHANGE IN THE SYSTEM CS_2–S^{35} FOR THE PREPARATION OF LABELLED CARBON DISULFIDE. V. A. Sokolov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.367-72.

The preparation of CS_2^{35} by isotope exchange with elemental S^{35} is described. The exchange in the CS_2–S^{35} system was carried out in metallic ampules of stainless steel. The exchange scheme, the exchange kinetics, and the dependence of exchange on the concentration of sulfur in CS_2 solution are discussed. The yield of CS_2^{35} was 80 to 84% and its calculated specific activity was 73 to 80 μc/ml. (M.C.G.)

3358 (AEC-tr-4497(p.473-8)) PREPARATION OF RADIOCOLLOIDS OF GOLD FOR THERAPEUTIC PURPOSES. N. G. Seryabryakov and E. K. Sakseev. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. po Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957 (1958). Izotopy i Izlucheniya v Khim., p.373-7.

A method was developed for the preparation of radioactive colloidal gold solutions labeled with Au^{198} for therapeutic use. A protective colloid was obtained which is stable to radioactivity. A method was also developed for the preparation of radioactive gold solutions in a silver "setting." (M.C.G.)

3359 (FTD-TT-61-72) ATOMIC BATTERIES. Kliment Soler. Translated from Pokroky mat., fys. a astron., 6: No. 1, 15-23(1961). 15p.

A description is given of the basic principles of the atomic battery, its development, and types of batteries being produced. The importances pointed out for this weak-current source of electric power include use of radioactive wastes as a power source, and use as power source in conjunction with transistors. Difficulties encountered in the construction of the batteries are listed, and methods used to overcome the difficulties are described. (auth)

3360 SOME ACHIEVEMENTS AND POSSIBILITIES OF THE USE OF RADIOACTIVE ISOTOPES AND OF NUCLEAR RADIATIONS IN THE SOVIET INDUSTRY AND SCIENTIFIC RESEARCH. P. L. Gruzin. Atomnaya Energ., 11: 379-94(Oct. 1961). (In Russian)

Applied nuclear physics, a new branch of science and technology, includes the utilization of isotopes and of nuclear radiations in science and industry, application of reactors and of charged-particle accelerators, and study of radiation effects. Many old processes were thus improved: the "tagged atom" technique presents high sensitivity and accuracy,–it allows determination of certain elements, such as P or Co in mixtures with an accuracy of about 10^{-10}%. Currently used radioactive methods in the Soviet Union include: study of the properties of materials, reaction mechanisms, analysis of impurities, structural determinations, geological prospecting for ores and coal, drilling for oil, instrumentation and control systems for mechanizing and automatizing industrial processes, development of new industrial methods, such as polymerization, sulfochlorination, oxidation, sterilization by means of radiation, removal of undesired electrostatic charges, quality control, and detection of cracks and other defects in manufactured goods. Radioactive logging methods are quite widespread. Use of radioactive techniques in metallurgy, chemical industry and Soviet research installations are described. (TTT)

3361 FUTURE ASPECTS OF THE INDUSTRIAL USE OF ISOTOPES IN GREAT BRITAIN. H. Sheard (United Kingdom Atomic Energy Authority, Radiochemical Centre, Amersham, Eng.). Atomwirtschaft, 6: 477-9(Oct. 1961). (In German)

The use of large irradiation facilities with gamma ray sources should, before long, become a routine industrial practice. The sterilization of medical accessories, the preservation of foodstuffs as well as various chemical irradiation processes appear particularly promising fields. The practical possibilities of industrial installations are covered together with examples from various fields of application. (auth)

3362 NEW TECHNICAL ISOTOPE APPLICATIONS IN FRANCE. C. Fisher (Centre d'Etudes Nucleaires, Saclay, France). Atomwirtschaft, 6: 479-82(Oct. 1961). (In German)

Industrial processes involving the application of radioisotopes were developed and set out in the Section d'Applications de Radioéléments of the CEA. The following practical applications were described: A warning system for travelling cranes, a method for the continuous analysis of iron and chalk in ore assays, the investigation of viscose circulation in the manufacture of synthetic fibres, the investigation of the distribution of dressing agents and activation analysis. (auth)

3363 DETERMINATION OF COAL SEAM THICKNESS BY THE GAMMA-GAMMA LOGGING CURVE. Yu. I. Bilotserkovets. Dopovidi Akad. Nauk Ukr. R.S.R., No. 8, 1030-3(1961). (In Ukrainian)

A method of determining the thickness of a coal seam by the gamma-gamma logging curve is described. The method is based on the use of six characteristic points of the curve found by calculating the limiting surface of the sphere of influence of the bore-hole instrument in gamma-gamma logging. (auth)

3364 EFFECT OF CAVERNS WHEN APPLYING THE METHOD OF GAMMA-GAMMA LOGGING. I. O. Garkalenko. Dopovidi Akad. Nauk Ukr. R. S. R., No. 8, 1034-8 (1961). (In Ukrainian)

The efficiency of gamma-gamma logging (GGL) is considerably reduced by the presence of caverns in wells. Caverns are registered on the GGL curve as positive anomalies which may be mistaken for coal seams in wells drilled for coal, or for a missed ore-containing horizon in ore-exploring wells. To ascertain the cause of the positive anomaly, working with probes of various length and with soft and hard source is recommended. The difference in the anomaly relationships when working with soft and hard sources permits ascertaining whether the anomaly is caused by the presence of a cavern or by a change in the rock density. The critical diameter for wells drilled for coal was established by studies on models. It was found that the effect of caverns can be reduced by using hard gamma-quanta in GGL. A considerably greater effect was obtained on using a holding device and screening the indicator and source with a lead screen on the side of the drilling fluid. (auth)

3365 THE PROBLEM OF DOSAGE IN THE USE OF IONIZING RADIATION FOR STERILIZATION. A. A. Fomin (Central Inst. for Post Graduate Medical Studies). Med. Radiol., 6: No. 9, 74-80(Sept. 1961). (In Russian)

An analysis is made of various radiation and radiation doses utilized for food sterilization. The radiosensitivity of microorganisms and the chemical and physical reactions of various food constituents to high doses of radiation are reviewed and tabulated. 137 references are included. (R.V.J.)

3366 ISSLEDOVANIYE SVOISTV TORFA I PROTEKAYUSHCHIKH V NEM PROTSESSOV PRI POMOSHCHI RADIOAKTIVNYKH IZOTOPOV. (Investigation of Peat Properties and Processes in Peat Deposits by Means of Radioactive Isotopes). M. P. Volarovich and N. V. Churaev. Moscow, Publishing House of the Academy of Sciences, 1960. 199p.

Applications of radioisotopes in fluid dynamics are investigated. The fluid properties and structure of peat, water flow in peat deposits, and determination of deposit volume and humidity are studied. The use of isotopes in studying mixing processes and machinery operation are also considered. 314 references are included. (R.V.J.)

ISOTOPE SEPARATION

Refer also to abstract 3875

3367 (AERE-Z/R-2629) A LABORATORY-SCALE PLANT FOR THE ENRICHMENT OF N^{15} USING THE 'NITROX' PROCESS. L. Gowland and T. F. Johns (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Sept. 1961. 23p.

A small plant is described which is capable of producing about 0.3 gm per day of N^{15} in a substantially pure state (99.8%), using the chemical exchange between nitric acid and nitric oxide. The plant, which consists of a cascade of two packed columns, each about 15 ft long, is fully automatic, yet contains no pumps nor any electronic or similar devices. (auth)

3368 (CEA-tr-A-981) PRODUCTION DE L'ISOTOPE STABLE ^{18}O PAR DISTILLATION A CONTRE-COURANT D'H_2O. (Production of the Stable Isotope O^{18} by Counter-Current Distillation of H_2O). E. Krell. Translated into French by P. Monnard from Chem.-Ingr.-Tech., 32: 233-40 (1960). 43p.

For the production of the stable isotope O^{18}, several separation procedures have been proposed and utilized, as for example thermodiffusion and chemical procedures. However, counter-current distillation of water appears to be the most feasible from the economic point of view. In this case H_2O^{18} is enriched at the foot of the column. Apparatus for continuous and discontinuous operation, as well as procedures combined with cascades, are described, which permit an O^{18} enrichment of 95 at.%. (tr-auth)

3369 (CEA-tr-X-281) MÉTHODE DE FABRICATION OU DE CONCENTRATION DE L'EAU LOURDE. (Development of a Method for Concentration of Heavy Water). Jomar Brun and Gunnar Randers. Translated into French from Norwegian Patent 84,254, Aug. 1952. 13p.

A method for the concentration of heavy water, which combines the fractional distillation method and the electrolysis method, is given. The method is characterized by the fact that water fed to the first stage of the electrolysis apparatus is enriched in heavy water by fractional distillation using the heat produced by the combustion of the hydrogen released during the electrolysis and/or the heat formed in the electrolysis cells. The efficiency of such an installation is discussed, and a sketch of the flowsheet for such a procedure is given. (J.S.R.)

3370 (CEA-tr-X-291) CONTRIBUTION A L'ÉTUDE DU COEFFICIENT DE PARTAGE DANS LA MÉTHODE DE DIFFUSION GAZEUSE. (Contribution to Study of Separation Coefficient in Method of Gaseous Diffusion). K. Tanaka. Translated into French from Nippon Kagaku Zasshi, 79: 740-4(1958). 24p.

An approximate calculation of the coefficient of separation during the first phase of separation by the method of gaseous diffusion was attempted by using uranium hexafluoride as an example. The results obtained have shown that in the intermediary domain between r (diameter of the micropore) < λ (mean free displacement) and r > λ; the first order combination of the Knudsen and Poiseuille flows permits an approximate calculation of the coefficient of separation. On the other hand it is known that if r = 1, the surface diffusion on the wall of the micropores affects the separation phases for a perfect gas. In the case where the square root of the mean distance l^2 at which a molecule adsorbed at the surface of the wall is approximately equal to the diameter of the opening r, the surface diffusion also affects the separation phases. Under these conditions, the solution of the diffusion equation which takes into consideration the surface diffusion permits the coefficient of diffusion to be found. (tr-auth)

3371 (CEA-tr-X-396) PROCÉDE ET DISPOSITIF POUR OBTENIR DE L'EAU LOURDE A DES DEGRÉS DE PURETÉ DIFFÉRENTS. (Process and Apparatus for Obtaining Heavy Water of Different Degrees of Purity). Jose Luis Otero de la Gandara and Marcos Gispert Benach. Translated from [Spanish] Patent 222,160 (Additive). 8p.

Improvements to Patent No. 222.160 ("Process and Apparatus for Obtaining Heavy Water of Different Degrees of Purity") are reported. The improvements consist in the use of plate columns or packed columns between the electrolytic cells instead of the condensers for the enriched water vapor. The improvements discussed are clarified by the use of a sketch. (J.S.R.)

3372 (NP-tr-817) SOME METHODS OF PRODUCING ENRICHED URANIUM 235. Ho Ping. Translated from K'o Hsueh T'ung Pao, No. 2, 36-41(Jan. 26, 1959). 10p.

Methods for producing uranium are described as gaseous diffusion, supersonic jet pump, super-centrifuge, magneto-ionic expansion, ionic migration, and electromagnetic separation. A comparative table on the methods is included for rate of production, separation factor, cost scale, material, problems, and present progress. (B.O.G.)

3373 (UCRL-Trans-732(L)) THE MASS FILTER AS AN ISOTOPE SEPARATOR. W. Paul and H. P. Reinhard. Translated by F. S. Baker (Univ. of California Lawrence Radiation Lab., Livermore) from Proc. Intern. Symposium Isotope Separation, Amsterdam, 1957. (1958), p.640-52. 18p.

A description is given of a high-frequency mass spectrometer for separating isotopes in small quantities. The spectrometer uses a strong focusing electric quadrupole field that makes the ions oscillate near the axis of the field and reach the collector. The separation is achieved by an additional h-f field, being small compared with the main field, and being in resonance with the motion of the "wrong" isotopes. These oscillate with increasing amplitudes and cannot pass the field. The mass filter does not need ions of homogeneous energy or well defined ion beams. The separation is not affected by a relatively high space charge. Within certain limits, space charge effects can be compensated by adjusting the parameters of the focusing field. The apparatus was tried with magnesium. A total ion current of 3 ma could be achieved at the collector. A further increase is possible by increasing the length of the field. (auth)

3374 SEPARATION OF ISOTOPES BY MEANS OF THERMAL DIFFUSION. A. E. de Vries. Chem. Weekblad, 57: 221-4(1961). [(In Dutch)]

Under the influence of a temperature difference in a gaseous or liquid mixture, little separation is obtained between the components. For isotopes this separation amounts to one per cent. The manner for increasing this separation in binary and ternary mixtures is dealt with. Thus by means of

thermal diffusion columns several isotopes are produced with a purity above 99 per cent: O_2^{18}, N_2^{15}, Cl_2^{35}, Cl_2^{37}, Kr^{84}, Kr^{86}, Ne^{20}, Ne^{21}, and Ne^{22}. An application of thermal diffusion for age estimation using C^{14} is also mentioned. (NPO)

3375 A METHOD OF SEPARATING ELECTRICALLY CHARGED PARTICLES. (to Osterreichische Studiengesellschaft fur Atomenergie G.m.b.H.). British Patent 878,042. Sept. 20, 1961.

A mass spectrometer for separating charged particles, particularly isotopes, is designed which utilizes a combination of alternating electric and electrostatic fields, with no magnetic field. The spectrometer comprises two or three condensers combined with modulators in such a way that ions passing through the spectrometer must obtain the maximum energy gain from the modulators in order to reach the collector. (D.L.C.)

3376 IMPROVEMENTS RELATING TO THE ELECTROLYTIC CONCENTRATION OF HEAVY WATER IN WATER. Jean Charles Seailles. British Patent 882,607. Nov. 15, 1961.

An electrolytic apparatus is designed for concentrating D_2O in water with a small expenditure of energy. The apparatus comprises a plurality of electrolytic cells formed by palladium plates and porous diaphragms. The palladium absorbs the evolved hydrogen and effects its recombination with oxygen, while foreign substances, including D_2O, are accumulated in certain compartments of the apparatus. (D.L.C.)

MATHEMATICS AND COMPUTERS

3377 (AD-257024) A NEW WAY OF SOLVING MAXWELL'S EQUATIONS. V. H. Rumsey (California. Univ., Berkeley. Electronics Research Lab.). Dec. 19, 1960. Contract DA 36-039 SC-84923. 18p.

A general solution of Maxwell's equations for a single frequency can be expressed as the combination of two types of solution, each of which is characterized by an electric vector which is equal to the magnetic vector times the intrinsic impedance of free space but a quarter cycle out of phase. These two types are mathematically orthogonal, and each can be conveniently expressed by means of a single scalar. The method leads to circularly polarized surface waves propagating along anisotropic sheets which are perfectly conducting in one tangential direction and perfectly transparent in the orthogonal tangential direction. (auth)

3378 (AD-257717) TRUNCATIONS IN THE METHODS OF INTERMEDIATE PROBLEMS FOR LOWER BOUNDS TO EIGENVALUES. Norman W. Bazley (National Bureau of Standards, Washington, D. C.) and David W. Fox (Johns Hopkins Univ., Silver Springs, Md. Applied Physics Lab.). Feb. 1961. Contract NOrd 7386. 30p. (CM-991)

Two new procedures are presented for determining lower bounds to eigenvalues of semi-bounded self-ajoint operators. The procedures are based on the method of intermediate problems. While phrased in the language of Hilbert Space, the procedures result in useful computational methods for the estimation of eigenvalues and eigenvectors of differential operators in classical and quantum mechanics. (auth)

3379 (AEEW-M-160) AN EXTENDED VERSION FOR HASSITT'S ONE-DIMENSION MULTI-GROUP DIFFUSION PROGRAMME FOR THE MERCURY COMPUTER. D. C. Bindon (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Aug. 1961. 12p.

An extended version of Hassitt's one-dimension multigroup diffusion program was prepared which allows for a maximum of twenty-two energy groups rather than sixteen. It also permits the use of drum storage by program and data up to the full machine capacity of 1024 sectors, rather than 478 sectors. Some minor corrections were made. A binary tape of an 830-sector version was prepared. (auth)

3380 (AERE-R-3830) A SCHEME FOR HANDLING FUNCTIONS ON A COMPUTER. M. J. D. Powell (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Sept. 1961. 42p.

A scheme to tabulate, add, multiply, integrate, and differentiate functions of a single variable was programmed for a Mercury computer. Details are given of the numerical analysis of the scheme, and the general features of the programs are described. (auth)

3381 (CREL-944) A SOLID-STATE 50-DIGIT MULTIPLEXER. J. Leng and L. B. Robinson (Atomic Energy of Canada Ltd., Chalk River, Ont.). July 1961. 36p. (AECL-1309)

A multiplexing unit is described which will allow automatic recording of up to 200 binary switch settings, or 50 binary-coded decimal digits. Input requirements are compatible with transistorized scalers presently in use at Chalk River, and the output can be recorded using a solid-state typewriter and tape-punch control unit. The multiplexing speed is limited only by the speed of the mechanical recording devices. (auth)

3382 (HW-63411) IDIOT—A LATTICE PARAMETER CODE FOR THE IBM-709. C. R. Richey (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 7, 1960. Contract AT(45-1)-1350. 26p.

IDIOT, an IBM-709 code, was programmed to compute lattice parameters for a unit lattice cell at a speed sufficient for survey type computing without sacrifice in analytical techniques. A P_3 solution to the Boltzmann transport equation is used to calculate the thermal neutron fine structure in the cell. The program will compute temperature-dependent parameters for either graphite- or D_2O-moderated lattices. The uranium can be irradiated metal, and fuel assemblies can either be a cluster of rods or a series of concentric cylinders. (D.L.C.)

3383 (HW-68858) A COMPUTER SOLUTION TO THE GENERALIZED LEAST SQUARES PROBLEM. J. R. Lilley and E. L. Kelley (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 15, 1961. Contract AT(45-1)-1350. 10p.

A description is given of a computer program for fitting virtually any function for which derivatives exist by the method of least squares. As many as 20 parameters may be determined by fitting the specified function to as many as 500 experimental points, and the analytic expression to be fitted may be a function of as many as 5 independent variables. The use of the program is described and instructions given for specifying the function to be fitted and preparing input data. (D.L.C.)

3384 (KAPL-M-GLB-6) TOLERANCE LIMITS FOR SMALL LOTS WHEN SAMPLE PIECES ARE SOMETIMES MISCLASSIFIED. G. L. Burrows (Knolls Atomic Power Lab., Schenectady, N. Y.). Sept. 20, 1961. Contract W-31-109-Eng-52. 15p.

Tables are presented that show the minimum number of pieces that must be examined from a lot in order to insure that a certain amount of the pieces meet desired specifications. Three different tables are presented in order that the correct sampling plan may be chosen. The first table gives the minimum sample size required from finite lots to provide assurance against an excessive number of defectives. The second table shows the increase in sample size necessary to obtain the same assurance against defectives as in the first table when defectives sampled from the lot may be erroneously classified as non-defective. The third table shows that possible errors in misclassifying both defectives and non-defectives lead to reductions rather than increases in sample size. Illustrations are given showing that protection against excessive defectives is achieved with reduced sample size only by a marked reduction in the probability of accepting acceptable lots. Illustrations are also given on how the minimum sample size criterion can be modified to get a sampling plan that provides assurance against an excessive number of defectives while at the same time accepting lots with low numbers of defectives with fairly high probability. (N.W.R.)

3385 (KAPL-M-NCF-3) NON-LINEAR EQUATION VARIATIONAL METHOD. N. C. Francis (Knolls Atomic Power Lab., N. Mex.). July 10, 1961. Contract W-31-109-Eng-52. 6p.

A nonlinear variational method is presented for the in-

homogeneous case of power reactor physics problems. (D.L.C.)

3386 (PIBMRI-937-61) THE DESIGN OF NONLINEAR AND ADAPTIVE SYSTEMS VIA LYAPUNOV'S SECOND METHOD. Lawrence P. Grayson (Brooklyn. Polytechnic Inst. Microwave Research Inst.). July 27, 1961. Contract DA-30-069-ORD-1560. 71p. (AROD-1538-19)

The second method of Lyapunov was investigated and utilized in synthesizing nonlinear and adaptive controllers for single-input-single-output, as well as multidimensional, processes. Attempts were made to obtain new design procedures from the existing theorems. The object of the three distinct techniques presented is to drive the process in such a manner that the process output follows a certain desired output. The procedures are presented for the general case, examples are given to illustrate the theory, and computer results shown to indicate "how well" the controlled systems operate. (auth)

3387 (SC-4643(M)) PRELIMINARY MANUAL FOR QUIKOD. A PROGRAMMING SYSTEM FOR THE IBM 709/7090 DATA PROCESSING MACHINES. L. E. West (Sandia Corp., Albuquerque, N. Mex.). Dec. 1961. Contract [AT(29-1)-789]. 62p.

QUIKOD is a coding system (containing 20 instructions) that can be used on either the IBM 709 or the IBM 7090 data processing machine. Developed to handle uninvolved but critical data processing tasks, its usefulness is not limited to any special class of job or to jobs of limited complexity. The complete SCAT language as provided by the IB Monitor 32K SOS system is available; therefore, SCAT instructions can be used with QUIKOD instructions, if necessary, to accomplish a given job. (auth)

3388 (TID-14295) TECHNICAL PROGRESS REPORT. PART I. HIGH-SPEED COMPUTER PROGRAM. PART II. CIRCUIT RESEARCH PROGRAM. PART III. DATA REDUCTION METHODS. PART IV. MATHEMATICAL RESEARCH USING COMPUTERS. PART V. ILLIAC USE AND OPERATION. PART VI. IBM 650 USE AND OPERATION. PART VII. GENERAL LABORATORY INFORMATION. (Illinois. Univ., Urbana. Digital Computer Lab.). Aug. 1961. Contract AT(11-1)-415. 51p.

Progress on a high speed computer includes tests on the main arithmetic unit, power supply fabrication, machine construction, circuit design, arithmetic control and end connection designs, design of simplified instruction sequencing control and advanced control systems, and magnetic tape design studies. Circuit research comprises studies of tunnel diodes, saturated transistors, and flip-flop circuits. Methods are under development for reducing data from bubble chamber photographs. Several uses of computers in mathematical research are outlined. The uses and operation of the Illiac and IBM 650 computers are reviewed. (T.F.H.)

3389 (TID-14296) TECHNICAL PROGRESS REPORT: PART I. HIGH-SPEED COMPUTER PROGRAM. PART II. CIRCUIT RESEARCH PROGRAM. PART III. DATA REDUCTION METHODS. PART IV. MATHEMATICAL METHODS. PART V. ILLIAC USE AND OPERATION. PART VI. IBM 650 USE AND OPERATION. PART VII. GENERAL LABORATORY INFORMATION. (Illinois. Univ., Urbana. Digital Computer Lab.). Sept. 1961. Contract AT(11-1)415. 52p.

Progress on a high speed computer program includes system construction, subsystem tests on the main arithmetic unit, circuit designs, interplay system designs, and magnetic drum memory development. Studies are reported of tunnel-diode, failsafe, and supersaturated transistor circuits. Techniques for using computers in Monte Carlo investigations in quantum statistics are described. The uses and operation of the Illiac and IBM 650 computers are reviewed. (T.F.H.)

3390 (SCL-T-388) PERIODICITY TEST. GENERALIZATION OF THE SCHUSTER TEST IN THE CASE OF TEMPORAL AUTO CORRELATED SERIES. Maurice Allais. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from Compt. rend., 244: 2469-71 (May 13, 1957). 5p.

Schuster's test, derived for the case of non-autocorrelated series of stochastic processes, is generalized for autocorrelated series. (D.L.C.)

3391 NOTES ON DISCRETE POTENTIAL THEORY. John G. Kemeny and J. Laurie Snell (Dartmouth Coll., Hanover, N. H.). J. Math. Anal. and Appls., 3: 117-21 (Aug. 1961).

A concrete example of a null chain for which the limits are not abel-summable is presented. It is the combination of two rooted trees, having 0 and 1 as roots, respectively. (L.N.N.)

3392 COMPARISON AND EXISTENCE THEOREMS FOR MULTICOMPONENT DIFFUSION SYSTEMS. A. McNabb (Dept. of Scientific and Industrial Research, Wellington, N. Z.). J. Math. Anal. and Appls., 3: 133-44(Aug. 1961).

It is shown that solutions of an equation for a nonlinear parabolic system contained in a region R of (x,t,u,w) space, satisfy comparison theorems of the second order in one dependent variable. These lead to uniqueness proofs for the Dirichlet and related problems. The comparison theorems are used in conjunction with theorems on a priori estimates for and existence of solutions of linear parabolic equations of the second order due to Friedman to derive corresponding solutions of the nonlinear parabolic system. The methods used are readily generalized and applied to systems involving many dependent variables such as those describing the multigroup diffusion of neutrons in fissionable matter or the flux of heat and moisture through porous solids. (L.N.N.)

3393 COMPUTER RESEARCH: MEDICINE, HUMAN ENGINEERING, AND LEARNING MACHINES. OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). Aug. 1961. 14p. (SB-473). $0.10(OTS).

A bibliography on computer research: medicine, human engineering, and learning machines is presented. The 139 references added to the Office of Technical Services' collection during the period 1959 through August 1961 are listed. (M.C.G.)

3394 COMPUTERS. OTS Selective Bibliography. Supplement to CTR-371. (Office of Technical Services, Washington, D. C.). Aug. 1961. 31p. (SB-472). $0.10 (OTS).

A bibliography on computers is presented. The 463 references added to the Office of Technical Services' collection during the period April 1959 to September 1961 are listed. (M.C.G.)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

Refer also to abstract 3912

3395 (BM-RI-5880) PREPARATION AND METALLIC REDUCTION OF RARE-EARTH HALIDES AND OXIDES. T. T. Campbell, F. E. Block, R. E. Mussler, and G. B. Robidart (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Apr. 1960. 33p.

The development of techniques for the preparation of high-purity rare-earth metals is described. Rare-earth metals, excepting samarium, europium, and ytterbium, were prepared by converting their oxides to anhydrous chlorides or fluorides and reducing the rare-earth halides with active metals such as lithium or calcium. High-purity, anhydrous rare-earth chlorides were prepared by dissolving the rare-earth oxides in hydrochloric acid to form hydrated chlorides and by subsequently dehydrating the hydrated salts in the presence of ammonium chloride at temperatures ranging from 70° to 360°C while under reduced pressure (50 microns to 1 inch Hg). The chlorides were also prepared by direct chlorination of rare-earth oxide-carbon mixtures. Reaction efficiencies in excess of 95% were obtained by either method; however, purer chlorides were prepared by the aqueous ammonium chloride conversion method. Purification of yttrium chloride by high-temperature vacuum distillation proved to be an effective method of separating oxygen-bearing compounds from the chloride. Yttrium metal prepared from purified chloride contained significantly smaller amounts of oxygen (990 ppm oxygen in yttrium metal prepared from raw chloride and 200 ppm in that prepared from distilled chloride). Rare-earth fluorides were prepared by a solid-state reaction between the rare-earth oxides and ammonium bifluoride. This reaction was characterized by high reaction efficiencies and almost 100% conversion of the oxides to anhydrous, oxygen-free fluorides. Both the chloride and fluoride salts were reduced to metal by metallic reduction under an inert atmosphere. Rare-earth metals of greater than 99% purity were prepared by inert-atmosphere crucible-reduction techniques. Reaction efficiencies of 95 to 99% were realized by reduction of the halides with calcium or lithium. Efforts to prepare rare-earth metals by bomb-reduction techniques were generally unsuccessful. Reactions performed in this manner were characterized by low yields and impure metal products. The application of vacuum-reduction techniques, that is, the Pidgeon process, for the preparation of samarium and europium was not only demonstrated to be technically feasible, but it also indicated that these techniques could readily be adapted to commercial production. Yields in excess of 90% were obtained by lanthanum reductions of europium oxide at temperatures as low as 900°C; the purity of the europium product was greater than 99%. (auth)

3396 (GAMD-2363) PART I. SURVEY OF DATA ON THE IRRADIATION EFFECTS OF ALUMINA AND INCONEL-X. PART II. LONG TERM CREEP RUPTURE DATA ON INCONEL-X IN THE ABSENCE OF RADIATION. W. L. Kosiba (General Atomic Div., General Dynamics Corp., San Diego, Calif.). June 29, 1961. Contract AT (04-3)-187. 20p. (MGCR-M-347)

The effects of neutron and γ radiation on the physical, electrical, tensile, mechanical, and crystalline properties of Inconel-X and alumina are presented in tabular form. The long-term (up to 40 khr) creep rupture of unirradiated Inconel-X is studied at 1200 to 1800°F. (T.F.H.)

3397 (NP-10984) RESEARCH AND DEVELOPMENT OF HIGH TEMPERATURE STRUCTURAL ADHESIVES. Quarterly Progress Report No. 2, December 1, 1960 to February 28, 1961. Harold H. Levine (Narmco Research and Development. Div. of Narmco Industries, Inc., San Diego, Calif.). Mar. 1961. Contract NOw-61-0254-c. 71p.

A semi-inorganic adhesive was found which gave approximately 700 psi after an hour at 900°F and approximately 900 psi after ten minutes at 1000°F. When heat soaked at 500°F in air, on steel, and tested at 500°F, this adhesive exhibited extremely good resistance to degradation for 1000 hours. A value of 1150 psi was obtained after 250 hours at 500°F. The adhesive remained unchanged in tensile shear strength from 500 to 1000 hours, giving 777 to 707 psi respectively. This behavior prompted a mechanism study to determine what reaction occurred between the organic adhesive and the inorganic reactant. Pyrolytic studies strongly suggested that treatment of an organic binder resin at 1800°F in argon will form a more oxidation resistant material. However, treatment at 1000°F results in a resin that oxidizes much more rapidly than even an untreated sample of the same system. The possibility of formation of new heat resistant polyphenyl type molecules under extreme temperature exposure is suggested by the studies. Polynuclear hydrocarbons were found to selectively inhibit free radical oxidation of diphenylmethane. During these mechanism studies, the formation of benzaldehyde was drastically reduced, indicating little bond rupture. However, oxidation to the more heat stable ketone, benzophenone continued. It is hoped that this will be useful in synthesizing more stable polymers or lead to a high temperature anti-oxidant. A brief re-evaluation of bonding techniques was started. By this approach it is believed that more reproducible data will be obtained, and thus permit better definition of trends which are required to indicate the validity of a given approach. The synthesis of the desired 3,3′-dialdehyde of Bisphenol-A was apparently successful but in very poor yields. (auth)

3398 (PAN-245/I-B) PREPARATION OF SINGLE CRYSTALS OF HIGH MELTING TEMPERATURE MATERIALS. S. Bednarski and A. Modrzejewski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). June 1961. 4p.

Single crystals of Co (about 20 mm in diameter), Co–Fe alloy (up to 45 mm in diameter), and of Ni (over 40 mm in diameter) and Ni–Fe alloys (about 20 mm in diameter) of various composition were grown by the Bridgman method. (auth)

3399 (CEA-tr-X-256) PROCEDE POUR OBTENIR DIRECTEMENT DES ALLIAGES DE BERYLLIUM D'UN TITRE SUPERIEUR A 25% EN BERYLLIUM AVEC N'IMPORTE QUEL METAL ALLIABLE, Y COMPRIS LE BERYLLIUM PUR. (Procedure for Obtaining Directly Beryllium Alloys of Concentration Greater than 25% Beryllium Using Any Miscible Metal, Including Pure Beryllium). Translated by L. Roulet from Italian Industrial Patent 349,185 (Addition to Patent 342,591). June 9, 1937. 10p.

A method is given of the direct production of Be alloys with Be concentrations greater than 25%. The method con-

sists in the reaction of a beryllium compound or mineral with a scorifying metal or metalloid in alloy having initially a specific weight higher than the beryllium compound used. Just below the fusion temperature of the scorifant, the reaction mass is violently agitated either by mechanical means or by electromagnetic induction. An almost maximum yield of the pure Be or the alloy is obtained. In an addendum to the original patent, it is reported that the process is facilitated if the alloying element is in a eutectic medium and if the medium melts at a temperature much lower than the fusion temperature of the components. (J.S.R.)

3400 (UCRL-Trans-729) PROPAGATION OF UNIDIMENSIONAL WAVES IN MATERIALS WITH DELAYED YIELDING. V. S. Lenskii and L. N. Fomina. Translated by S. Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Mekhan. i Mashinostr., No. 3, 133-6(1959). 14p. (Includes original, 4p.).

A physical interpretation is given of the phenomenon of delay of yielding for the existence of a dependence between the tensions, deformations, and time for the dislocation theory in the propagation of longitudinal elastically plastic waves in rods. (B.O.G.)

3401 VALENCY OF IONS FORMED DURING ANODIC DISSOLUTION OF METALS IN ACIDS. M. E. Straumanis (Univ. of Missouri School of Mines and Metallurgy, Rolla). J. Electrochem. Soc., 108: 1087-92(Dec. 1961).

The charge of cations of active metals, going anodically into solution in acid of alkaline electrolytes, can be computed from the current applied and the total hydrogen evolution rate after the initial, self-dissolution rate is subtracted. However, under such conditions an ionic charge, experimentally not provable, of much higher or lower value than the normal one is calculated. Evidently this charge is apparent and corresponds to the true one only then, if the self-dissolution rate does not change when the anodic current is applied. It can be shown (by measuring the total hydrogen volume developed) that calculated abnormal valencies result when the change of self-dissolution rate (difference effect) due to the anodic current is disregarded. In the case of the positive effect, high charges and, in the case of the negative effect, low (apparent) cationic charges are computed. The impossibility of the calculated high cationic charges proves in turn that the positive effect cannot be explained by the expulsion of such cations by the anode. Since it was shown at least in the case of Be (which also might be true with Mg) that the metal partially disintegrated into tiny metal particles under the influence of the anodic current, the need for the assumption of Be^{+} formation is removed. The appearance of the negative Δ effect can be explained in a better way. All the phenomena occurring in the anodic compartment in acidic as well as neutral solutions can be explained readily by the consequences of the altered self-dissolution rates, especially if the activation of the dissolving surface of the anodic metal, the breakdown of the protective films, and the formation of metal fragments by the anodic current are considered. (auth)

3402 ZIRCONIUM AND ITS APPLICATION. F. Sperner (Heraeus-Gesellschaft m.b.H., Hanau, Ger.). Metall., 15: 892-4(Sept. 1961). (In German)

The good corrosion resistance of zirconium and its mechanical and physical properties make it of wide applicability. Its utilization in reactor structure, construction of chemical apparatus, and electronics is reviewed. (J.S.R.)

3403 ADHESIVES. OTS Selective Bibliography. Supplement to CTR-300. (Office of Technical Services, Washington, D. C.). Apr. 1960. 8p. (SB-406). $0.10 (OTS).

A bibliography on adhesives is presented. The 98 references collected by the Office of Technical Services as published from 1944 through 1959 are given. (M.C.G.)

3404 IMPROVEMENTS IN OR RELATING TO THE EXTRACTION OF THORIUM FROM THORIUM CHLORIDE AND TO THE PRODUCTION OF MAGNESIUM–THORIUM ALLOYS. Frank Pitts (to Magnesium Elektron Ltd.). British Patent 882,311. Nov. 15, 1961.

An improved process is given for producing a Mg–Th alloy from a chloride mixture containing thorium chloride. The process comprises treating the fused mixture with Mg in excess of that required to precipitate Th to form a Mg–Th alloy containing up to 50% Th and at least 10% Mg. (D.L.C.)

Corrosion

3405 (ANL-6204) SUMMARY OF CORROSION INVESTIGATIONS OF HIGH-TEMPERATURE ALUMINUM ALLOYS, OCTOBER 1957–DECEMBER 1959. Norbert R. Grant (Argonne National Lab., Ill.). Sept. 1961. Contract W-31-109-eng-38. 81p.

Long-term dynamic tests have provided additional information on the corrosion rate of aluminum X-8001. In five tests, the rate varied from near zero to 15 $mg/dm^2/day$. The most important factors affecting corrosion were water velocity, pH (including a water additive), temperature, and surface-area-to-water volume ratio. The effect of several of these was known previously, but some had not been thoroughly investigated. In general, for this series of tests, there was a benefit by decreasing the pH from 7 to 5. This benefit was magnified greatly if phosphoric acid was used to decrease the pH. However, when the pH was extended to 4.5 with phosphoric acid, the corrosion, although extremely low, was no longer a uniform type of attack. The effect of increasing temperature was to increase the corrosion rate, as had been noted previously. The effect of the ratio of corroding aluminum surface area to volume of circulating water was directly measured for the first time. The test at 260°C indicated that for the dynamic section of the loop the metal loss decreases as this ratio increases. This helps to explain the reason for higher corrosion results in tests such as the in-reactor test loop in MTR, where this ratio is quite low. Other variables which have a lesser or negligible effect were also investigated. Surface boiling caused by higher corrosion, although the question of how much this is caused by increased surface temperature is not known. Tests of in-reactor fuel plates also gave similar results, but also have the same question. Coupling effects are negligible unless the water quality becomes very poor. (auth)

3406 (GEAP-3729) THE EFFECT OF HEAT TREATMENT ON THE CORROSION RESISTANCE AND CORROSION HYDROGEN EMBRITTLEMENT OF SOME Zr–Nb BINARY ALLOYS. H. H. Klepfer, W. V. Cummings, and R. E. Blood (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). May 22, 1961. 29p. (R61APE51)

The effect of four different heat treatments on the corrosion resistance and hydrogen embrittlement of 1.0 wt % Nb, 1.5 wt % Nb, and 3.5 wt % Zr–Nb alloys was studied. The results are discussed in terms of both practical application of the alloys and in terms of the mechanism of corrosion. Annealing for 8 hr at 1100°F after cold working

gives a metastable structure with excellent corrosion resistance in both water and steam, and gives a structure whose corrosion resistance is relatively insensitive to Nb content. Heat treatment per se leads to significant differences in impact energy absorption after equivalent corrosion exposures and at equivalent hydrogen levels. The alpha annealed structure shows a low susceptibility to hydrogen embrittlement. (auth)

3407 (KAPL-M-BED-4) THE CORROSION BEHAVIOR OF HAFNIUM AND HAFNIUM ALLOYS IN HIGH TEMPERATURE WATER AND STEAM. B. E. Dearing and A. M. Andrako (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 14, 1961. Contract W-31-109-Eng-52. 16p.

Synthetic hafnium alloys containing tantalum, lutetium, and tungsten were corrosion tested in 550 and 680°F deoxygenated-deionized neutral water, and in 680 and 750°F steam. In addition, the alloys were corrosion tested in pH 11.0 LiOH and pH 10.0 NH_4OH environment. Alloy additions of 0.36 wt % tantalum and 0.094 wt % lutetium to hafnium produced a measurable decrease in the corrosion resistance to 550°F water. At 680°F the corrosion behavior of the hafnium alloys appears to be more sensitive to steam than water. Tests in high pH environments (pH 11 LiOH and pH 10 NH_4OH) showed the corrosion resistance of the hafnium alloys tested was not adversely affected when compared with 680°F water. Alloy additions as low as 0.22 wt % tantalum and 0.07 wt % lutetium produced a measurable decrease in the corrosion resistance of hafnium in 750°F steam and 680°F water. Additions of tungsten drastically decreased the corrosion resistance of hafnium. Additions of 0.05 wt % iron to hafnium alloys containing 0.4 wt % tantalum improved the 750°F steam corrosion resistance but did not completely counteract the adverse effect of tantalum. Iron additions to hafnium alone can improve the 750°F steam corrosion resistance and leave the good 680°F water corrosion resistance unaltered. Additions of iron and tin to hafnium, however, reduced the corrosion resistance to 750°F steam. A heat treatment of 1 hour at 1150°C followed by a rapid air quench was found to sharply reduce the corrosion resistance of hafnium in 750°F steam. (auth)

3408 (NP-11119) PROTECTION OF NIOBIUM AGAINST OXIDATION AT ELEVATED TEMPERATURES. Final Report. G. M. Gordon and Rudolph Speiser (Ohio State Univ. Research Foundation, Columbus, Ohio). Oct. 14, 1961. Contract N6onr-225(28). 68p.

A mechanism is proposed for the oxidation of a series of Nb–Zr and Nb–Ti–Zr alloys in air at temperatures above 700°C. This mechanism is based on the mode of nucleation of alpha zirconium from oxygen-saturated beta solid solution. Metallographic and x-ray diffractometric techniques were used in the formulation of the proposed mechanism. (auth)

3409 (RLI-5(Rev.)) CHALK RIVER EXPERIENCE IN "CRUD" DEPOSITION PROBLEMS. R. F. S. Robertson (Atomic Energy of Canada Ltd., Chalk River, Ont.). Revised Aug. 15, 1961. 29p. (AECL-1328)

Presented at Tripartite Conference on Transport of Materials in Pressurized Nuclear Systems, February 28 and March 1, 1961.

Data are summarized on the deposition of corrosion products on fuel element surfaces in high-temperature water-cooled loops. Some data are included on the deposition of corrosion products on the sheaths of the fuel in the NRX reactor. An attempt is made to correlate results with present theories concerning deposition of particulate matter on surfaces through which high heat and radiation fluxes are passing. (C.H.)

3410 REACTION OF ZIRCONIUM WITH CARBON DIOXIDE AT 550-750 C. S. J. Gregg (The University, Exeter, Eng.), R. J. Hussey, and W. B. Jepson. Corrosion, 17: 575t-8t(Dec. 1961).

The kinetics of the oxidation of zirconium in C^{14} labeled carbon dioxide were investigated at 550, 650, and 750°C with the vacuum microbalance. The amount of carbon deposited on the sample surface during oxidation in carbon dioxide was only about 2 percent of the total weight gain at each of the temperatures. In carbon dioxide, the rate of oxidation first decreased and then increased with time indicating breakaway. In runs in oxygen, the rate continuously decreased with time and breakaway did not occur within the period of the experiments. Maximum weight gain was 900 $\mu g/cm^2$. (auth)

3411 HIGH-TEMPERATURE OXIDATION OF SOME ALLOYS OF TITANIUM AND TANTALUM WITH ZIRCONIUM. R. F. Voitovich and R. V. Makarova (Inst. of Metal-Ceramics and of Special Alloys, Ukrainian Academy of Sciences). Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 4, 95-100(July-Aug. 1961). (In Russian)

The little-known corrosion-resisting properties of Ti–Zr and Ta–Zr alloys were investigated by following the oxidation of the alloys using a continuous weighing method. The Ti–Zr system consists of a continuous series of solid solutions while Ta forms eutectic type limited-solubility alloys with Zr. Ti alloys containing 30, 70, and 90% Zr and Ta alloys with 10, 30, and 70% Zr were used for the tests. Thermodynamic calculations indicate that between 500 and 900°C the higher Ti oxides are reduced to lower oxides by Zr, yielding primarily TiO. In the Ta–Zr system the alloys containing small amounts of Zr are only slightly oxidized in view of the formation of a protective oxide film. At higher Zr concentrations the alloys are more heavily attacked, probably because of stresses formed in the protective layer. As a general rule it is concluded that alloying of Ti and Ta with Zr leads to a marked decrease of the high-temperature oxidation resistance of these alloys, especially at temperatures beyond 600°C. (TTT)

3412 A MICROSCOPIC STUDY OF OXIDE FILMS ON URANIUM. L. Leibowitz, J. G. Schnizlein, L. W. Mishler, and R. C. Vogel (Argonne National Lab., Ill.). J. Electrochem. Soc., 108; 1153-5(Dec. 1961).

Microscopic examination of the surface of uranium during the course of its oxidation has shown that the appearance and growth of oxide nodules coincide with the start of an increase in oxidation rate. Oxidation mechanisms are discussed, and the effects of oxide film cracking and surface area changes are considered. (auth)

3413 THE KINETICS OF OXIDATION OF URANIUM BETWEEN 125° and 250°C. L. Leibowitz, J. G. Schnizlein, J. D. Bingle, and R. C. Vogel (Argonne National Lab., Ill.). J. Electrochem. Soc., 108: 1155-60(Dec. 1961).

Rates of oxidation of uranium are measured volumetrically at constant pressure in the temperature range 125° to 250°C and at oxygen pressures from 20 to 800 mm. The oxidation is best described by two linear rate laws. Results show that a marked increase in rate occurs after an average of 50 μg O_2/cm^2 is consumed. The first stage rate in $\mu g/cm^2$-min is given by the expression $v_1 = 1.48 \times 10^4 P^{1/n} e^{-E/RT}$ where E = 10,700 cal, P is oxygen pressure in millimeters of mercury, and 1/n varies with temperatures. The reaction is believed to be controlled by process occurring at the gas-oxide surface. The increase in rate

leading to the second stage is not treated quantitatively, but is attributed to a net increase in surface area. (auth)

3414 THE EFFECT OF AN ELECTRIC DISCHARGE ON THE OXIDATION KINETICS OF URANIUM. J. G. Schnizlein, J. D. Bingle, and L. Leibowitz (Argonne National Lab., Ill.). J. Electrochem. Soc., 108: 1166-7(Dec. 1961).

It has been observed that a variety of gas-solid reactions will proceed at an enhanced rate if the gas is activated by an electric discharge. Low has clearly demonstrated the pronounced effect of a Tesla coil discharge in increasing the adsorption of oxygen on a variety of metals. An investigation was made of the effect of such an excitation and it is these exploratory measurements which are reported for uranium. Results show a marked increase in oxygen consumption from the application of the discharge. (auth)

3415 KORROZIYA REACTORNYKH MATERIALOV. SBORNIK STATEI. (Corrosion of Reactor Materials. Collection of Papers). V. V. Gerasimov, ed. Moscow, State Publishing House of Literature on Nuclear Science and Technology, USSR, 1960. 284p.

A collection of articles is presented on corrosion in water at high temperatures and pressures. The effects of water purity on corrosive processes are studied. Some papers deal with the mechanisms of corrosion cracking and the effects of external and internal factors on the corrosion of austenitic stainless steel under stress. The effects of thermal treatment and metal composition on intercrystalline corrosion are also analyzed. In addition, studies are made of the corrosion behavior of zirconium alloyed steel and the effects of cracks and contacts with other metals. Corrosion product removal from reactors is also considered. (R.V.J.)

Fabrication

Refer also to abstract 3274

3416 (AERE-R-3703) AN INVESTIGATION INTO SOME ASPECTS OF THE ELECTRO-SPARK EROSION PROCESS WITH PARTICULAR REFERENCE TO THE CUTTING OF URANIUM. B. A. Campbell and J. G. Elliot (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). July 1961. 87p.

The fundamental principles of the electro-spark erosion process are outlined, and the various theories advanced to explain the phenomenon are briefly discussed. The essential features of a typical electro-spark erosion machine are fully described. The results of investigations into the effect of the numerous operating parameters on machining characteristics are given, particular attention being paid to the use of this method as a first step toward producing tensile test specimens from uranium. Details of the effects of the process on the surface structure of uranium are also given. Contributions to the theory of the electro-spark erosion phenomenon are made and suggestions for future research listed. (auth)

3417 (ASD-TR-7-532a(IV)) MACHINING OF REFRACTORY MATERIALS. PHASE II. Technical Engineering Report, August 1, 1961–October 31, 1961. L. J. Nowikowski, N. Zlatin, and M. Field (Metcut Research Associates Inc., Cincinnati). Nov. 1961. Contract AF33(600)-42349. 151p.

Machining studies were performed on pressed and sintered unalloyed tungsten, TZM molybdenum alloy, unalloyed columbium, D-31 columbium alloy, Rene 41 solution treated to 321 BHN and Rene 41 aged to 365 BHN. The investigation consisted of turning, face milling, end milling and grinding tests on tungsten; turning, face milling, drilling and grinding tests on molybdenum; drilling and grinding tests on columbium; and drilling, face milling, end milling, [illegible]otting and grinding tests on Rene 41. Machinability testing performed to date on 93% dense tungsten has shown the following: in turning, a tool life of 19 minutes was obtained with a K-11 carbide at a cutting speed of 100 feet/min, a feed of 0.009 inches/rev and soluble oil. Tool life in face milling was 28 inches of work travel with a 999 carbide at 75 feet/min, a feed of 0.010 inches/tooth and highly chlorinated oil. End mill slotting with a $1\frac{1}{4}$ in. diameter cutter with K-8 carbide gave a tool life of 45 inches of work travel at 200 feet/min, a feed of 0.003 inches/tooth and soluble oil. Grinding is difficult and G Ratios were low, 1 to 3. TZM molybdenum machines quite well. Cutting speeds of 350 to 400 feet/min can be used in turning and face milling with C-2 grades of carbide. Tool life is 25 minutes in turning with a 0.009 inches/rev feed, and 60 inches of work travel in face milling at a feed of 0.005 inches/tooth. Drilling with M-1 high speed steel drills produced a drill life of 95 holes at a speed of 130 feet/min, a feed of 0.005 inches/rev, with highly chlorinated oil. The grinding characteristics of TZM, however, are poor and low G Ratios, 4 to 6, were obtained in the surface grinding tests. A drill life of 175 holes was obtained on D-31 columbium with $\frac{1}{8}$ in. diameter M-1 high speed steel drills at 75 feet/min, 0.005 inches/rev feed with highly chlorinated oil. G Ratios for unalloyed columbium were low, 2 to 3, for the various grinding conditions investigated. Tables giving specific recommendations for machining Rene 41 in the solution treated and the solution treated and aged conditions are presented in the report. (auth)

3418 (ASD-TR-7-785) MOLYBDENUM ALLOY EXTRUSION DEVELOPMENT PROGRAM. Third Interim Technical Engineering Report, May 15, 1961–August 15, 1961. P. A. Santoli (Allegheny Ludium Steel Corp. Research Center, Brackenridge, Penna.). Oct. 1961. Contract AF33(600)-40861. 43p.

The evaluation of Phase II solid round extrusions of wrought and cast Mo–Ti–C–Zr alloy (TZM) was completed. The extrusions were characterized by a wide difference in microstructure from front to back and by the lack of a uniformly strain-hardened structure. Creep-rupture tests of forged TZM in the recrystallized condition were completed at 2000, 2400, and 3000°F in vacuum. TZM billet stock was hot forged to extrusion billet size with a uniform, fine grain macrostructure. (auth)

3419 (ASD-TR-61-124) EXPLOSIVE WELDING. Vasil Philipchuk (American Potash & Chemical Corp. National Northern Div., West Hanover, Mass.). May 1961. Contract AF33(616)-6797. 15p.

Methods were developed for the successful welding by the use of explosive forces of 4340 Steel to 4340 Steel, 6 Al–4V Titanium to 6 Al–4V Titanium, and Molybdenum to 310 Stainless Steel. No success was achieved with B120 VCA Titanium to B120 VCA Titanium and Molybdenum to Molybdenum. Test specimens were in sheet or strip form. All welds were lap-type, with one piece of metal directly over or lapped over the other. Successful welds of the above three metal combinations indicated that explosive forces can be utilized for lap weldments of sheet metals when the proper test parameters and techniques are investigated and developed. (auth)

3420 (DMIC-161) DEPARTMENT OF DEFENSE REFRACTORY METALS SHEET-ROLLING PROGRAM. Status Report No. 1. H. R. Ogden (Battelle Memorial Inst. De-

fense Metals Information Center, Columbus, Ohio). Nov. 2, 1961. Contract AF33(616)-7747. 31p.

Progress in the development of production techniques for high-quality, consistent sheet products from the refractory metals and their alloys is reported. The establishment of minimum data required to evaluate mill production is discussed. (M.C.G.)

3421 (HW-67938) THE HEAT TREATMENT OF PLUTONIUM. H. R. Gardner (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 1961. Contract AT(45-1)-1350. 27p.

Two groups of plutonium bars, one group containing 165 ppm iron and the other 678 ppm iron were end-quenched from the beta, gamma, delta, delta-prime, and epsilon phases. In general, cooling rate was found to have three striking effects on microstructure. The alpha grain size was found to decrease with increasing cooling rate during cooling from all phases. Upon cooling high-iron plutonium from the epsilon phase, the size of the $Pu-Pu_6Fe$ eutectic network decreased with increasing cooling rate. Cooling high-iron plutonium from temperatures between 413 and 460°C produced a wide variety of $Pu-Pu_6Fe$ configurations in the microstructure. Finally, the size of an unidentified spheroidal inclusion, soluble in the delta and higher temperature phases, decreased as cooling rate increased across the delta to gamma transformation. These effects of cooling rate can be used to indicate the cooling rate or thermal history that a particular plutonium specimen has encountered. A linear relationship between the alpha grain size and the $Pu-Pu_6Fe$ eutectic network size was observed. The network size was roughly two times larger than the alpha grain size. Hardness traverses on each of the bars indicated no apparent effect of cooling rate during quenching on hardness. A density decrease was noted near the quenched end of both low and high-iron bars which indicated that faster cooling rates promote microcracking. However, a greater decrease in density was obtained for the low-iron bars which was attributed to their greater tendency to microcrack. The presence of the $Pu-Pu_6Fe$ eutectic network in the high-iron bars inhibits microcracking. (auth)

3422 (HW-69679) RECOVERY AND RECRYSTALLIZATION OF ZIRCONIUM AND ITS ALLOYS. PART 2. ANNEALING OF COLD-WORKED ZIRCONIUM. D. L. Gray (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1961. Contract AT (45-1)-1350. 65p.

Hardness, x-ray diffraction, electrical resistivity, and metallography were used to study the annealing of cold-worked zirconium at temperatures from 300 to 800°C (570 to 1470°F). Cold work, annealing time, temperature, and furnace atmosphere were chosen as variables. Recrystallization of 25 and 50 per cent cold-worked zirconium occurred by nucleation and growth of new grains and was complete after 10 minutes at 650°C (1200°F) and 620°C (1165°F); 100 minutes at 620°C (1148°F) and 600°C (1110°F); 1000 minutes at 590°C (1095°F) and 550°C (1020°F), respectively. Recrystallization of 10 per cent cold-worked zirconium seemed to proceed by the growth of existing grains within a partially annealed matrix. After 10, 100, and 1000 min anneals recrystallization was complete at 670°C (1240°F), 650°C (1200°F), and 610°C (1130°F). For 10, 25, and 50 per cent cold-worked zirconium, the as-recrystallized grain size was 0.045, 0.026, and 0.016 mm, respectively. Grain growth following recrystallization was negligible. The highest value of n in the equation $D = kt^n$, where D is the grain diameter, n and k are constants, and t the time of anneal, was 0.07, describing growth during annealing of 50 per cent cold-worked zirconium. Secondary recrystallization occurred after vacuum anneals at 800°C (1470°F) for long periods of time. Anneals in air or commercial ungettered helium had no effect on recovery, recrystallization, or grain growth kinetics, but did inhibit secondary recrystallization. Impurities were picked up during the air and helium anneals and to a much smaller extent during elevated temperature anneals in vacuum (10^{-4} to 10^{-5} mm mercury). (auth)

3423 (KAPL-M-SAT-7) JOINING B^{10} STAINLESS STEEL PLATES BY THE RESISTANCE FOIL-SEAM WELDING PROCESS. S. A. Toftegaard and N. Norton (Knolls Atomic Power Lab., Schenectady, N. Y.). Oct. 18, 1961. Contract W-31-109-Eng-52. 10p.

A technique for joining boron-10 stainless steel plates by the resistance foil-seam welding process is established. The joint strength produced exceeded the requirements for normal routine handling. The total joint reinforcement thickness did not exceed 0.003 in. and for most welds the thickness increase is 0.002 in. or less. The weld has good appearance and strength adequate to withstand a 180° free bend around a $\frac{1}{2}$ in. radius, with some reverse bending to a lesser degree. (N.W.R.)

3424 (LA-2621) COMPACTION AND SINTERING OF PuO_2-Mo POWDER MIXTURES. W. C. Pritchard, K. A. Johnson, J. A. Leary, and W. J. Maraman (Los Alamos Scientific Lab., N. Mex.). Aug. 23, 1961. Contract W-7405-ENG-36. 45p.

The effects of compaction pressure and sintering temperatures on pellets of Mo powder and mixtures of Mo and PuO_2 powders were investigated. The pellets were cold compacted up to pressures of 100 tsi, followed by sintering in argon at temperatures up to 1750°C. Pellet densities of 94 to 95% theoretical were obtained. Measurements were made of hardness and electrical resistivity of the sintered pellets and correlated with metallographic examinations. Thermal cycling tests were conducted on a portion of the pellets. (auth)

3425 (LAMS-2612) THE POWDER ROLLING OF MOLYBDENUM AND TUNGSTEN. W. H. Lenz and C. E. Peterson (Los Alamos Scientific Lab., N. Mex.). June 1961. Contract W-7405-Eng-36. 41p.

The powder-rolling process was extensively investigated for Mo and W, including mixtures of $W-UO_2$. The powder-rolled Mo strip could be hot-rolled to sheet sufficiently ductile at 0.020-in. thickness to permit cold stamping of flat shapes; foil of 0.003-in. thickness was also produced. Additional processing of W or $W-UO_2$ strip, other than sintering, was not attempted. (auth)

3426 (NP-11072) BERYLLIUM CASTING. Interim Technical Engineering Report No. 10, Reporting Period, July 5, 1961 to November 4, 1961. B. H. Hessler and J. P. Denny (Beryllium Corp., Reading, Penna.). Contract AF33(600)-37902. 27p.

Methods were developed for the production of sound three-inch diameter vacuum-cast beryllium billets suitable for fabrication. The casting technique relies on a thermal gradient within the mold (hot top, cold bottom) to control directional solidification of the metal and eliminate the centerline shrinkage encountered in conventionally cast billets. The thermal gradient casting technique has been found to be reliable and reproducible. Ingots produced by this process show no indication of cracking as determined by radiographic tests and sectioning. Flat beryllium slabs have also been cast using this technique, and these are now being evaluated for soundness. (auth)

3427 (NP-11124) A STUDY OF EXPLOSIVE FORMING SELECTED REFRACTORY METALS. Progress Report No. 3, September 1, 1961 through October 31, 1961. (Chromalloy Corp. Propellex Chemical Div., Edwardsville, Ill.). Nov. 15, 1961. Contract NOw 61-0832-c. 25p.

Techniques necessary for the application of high-temperature strain gages were developed. A study of other possible methods of obtaining high-energy deformation rates was begun. A method was developed which consists basically of producing a d-c voltage that is directly proportional to the forming velocity of the metal blank. The draw ring modification to the 4-in. cup die was completed. A method was developed to obtain proper gridding of the tungsten plates. The instrumentation necessary to measure and record strain rate was also completed and used. (M.C.G.)

3428 (NYO-9725) ELECTRODES FOR WELDING TYPE 347 STAINLESS STEEL, SUMMARY REPORT. T. J. Moore (Arcos Corp., Philadelphia) and R. B. Gunia (United Steel Corp., Pittsburgh). July 31, 1961. Contract AT(30-1)-1233. 221p.

In a ten-year study of filler metal compositions and techniques for welding niobium-stabilized 18-8 stainless steel, seven electrode compositions were evaluated. The correct choice among these electrodes depends on the temperature, surroundings, and other conditions of service. It was confirmed that weld metals containing ferrite are highly resistant to hot-cracking and fissuring. However, one undesirable effect of ferrite-bearing weld metal is the tendency for the ferrite phase to transform to the brittle sigma phase during service at elevated temperature. In order to avoid the ferrite-to-sigma transition, it would be desirable to use fully austenitic Type-347 welds. Both high-carbon and high manganese Type-347 electrodes were included in the development and testing program. Tests of a partially ferrite Type-308L weld indicated that this composition was the most corrosion resistant of the compositions tested. The ability to retain notch-toughness after exposure to elevated temperatures and the retention of notch-toughness at extremely low temperatures were also higher for Type-308L. The principal drawback to the Type-308L weld deposit was its low elevated temperature strength, compared with Type-347 material. The addition of nitrogen to Type-308L improves the properties. An electrode containing 16% chromium, 8% nickel, and 2% molybdenum was shown to have some desirable properties for certain applications. Both Type-308L and -347 were shown to have extremely high corrosion rates after aging in the 800 to 1050°F range. The corrosion danger zone for 18-8 weld metals at 800°F begins at 1000 hours. (N.W.R.)

3429 (SCNC-322) ISOSTATIC FORMING OF BERYLLIUM. J. Fugardi and I. Sheinhartz (Sylvania Electric Products Inc. Sylcor Div., Bayside, N. Y.). Feb. 1961. Contract Nord-17017. 45p.

The feasibility of using the isostatic forming process to fabricate beryllium parts has been demonstrated on two specific parts. These were a cylindrical tube with a closed hemispherical end and a cylindrical tube with a 16 degree funnel section. Tests made on sections of isostatically formed beryllium indicate that it has properties equivalent to conventional hot pressed material in respect to yield strength, tensile strength and elongation. (auth)

3430 (SEP-256) FUNDAMENTALS OF DIFFUSIONAL BONDING-V. Fifth Annual Progress Report, July 1, 1959 through June 30, 1960. L. S. Castleman, H. A. Froot, and L. Seigle (General Telephone and Electronics Labs. Inc., Bayside, N. Y.). June 30, 1960. Contract AT(30-1)-2102. 30p.

An exploratory investigation has been completed of the effects of applied pressure on the kinetics of growth of intermetallic layers in the Al–Th system. Contrary to an earlier published report, no appreciable effect of pressure is found, and the growth kinetics appear to be conventional. Also, preliminary data were obtained on the effects of pressure on the kinetics of growth of the beta brass intermetallic layer in saturated alpha brass vs. saturated gamma brass couples. (auth)

3431 (SEP-258) FUNDAMENTALS OF DIFFUSIONAL BONDING. VI. Sixth Annual Progress Report, July 1, 1960–June 30, 1961. L. S. Castleman, H. A. Froot, and L. Seigle (General Telephone and Electronics Labs. Inc., Bayside, N. Y.). July 26, 1961. Contract AT(30-1)-2102. 36p.

The study of the effects of pressure on the kinetics of growth of intermetallic layers in binary diffusion couples was continued. It was found that pressure diminishes beta-brass layer growth in saturated alpha-brass vs. saturated gamma-brass diffusion couples both above and below the critical transition temperature range for ordering. The effect of pressure appears to be less in the ordered temperature range. In the aluminum-uranium system, the growth of the UAl_3 intermetallic layer, contrary to expectations, is not diminished in the pressure range 10 to 100 tsi. An argument is advanced, based on the activation volume concept, that the aluminum ions diffuse in UAl_3 by an interstitial mechanism. (auth)

3432 (VDIT-40) THE VIBRATORY COMPACTING OF POWDERS, IN PARTICULAR AS APPLIED TO URANIUM DIOXIDE. A Literature Survey. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Nov. 1961. 5p.

Abstracts are presented of 14 recent publications on the vibratory compacting of powders, with emphasis on UO_2. (C.H.)

3433 (VDIT-46) PREFERRED ORIENTATION AND RECRYSTALLIZATION IN FABRICATED ZIRCONIUM, URANIUM, AND THEIR ALLOYS. A Literature Survey. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Nov. 1961. 14p.

The survey consists of 29 annotated references to articles appearing in current periodicals: Nuclear Science Abstracts, Vol. 11, 1957 to Vol. 15, 1961; The Review of Metal Literature, Vol. 17, 1960 to Vol. 18, 1961; and The Atomic Industry Reporter. (B.O.G.)

3434 INCREASE OF THE HARDNESS OF STEEL BY SHOT-PEENING. I. V. Kudrayavtsev and E. V. Rymynova (Central Scientific Research Inst. of Heavy Machinery, [USSR]). Metalloved. i Termicheskaya Obrabotka Metal., No. 10, 29-33(Oct. 1961). (In Russian)

Surface treatment of steels by shot-peening or rolling is always accompanied by an increase of the hardness of the metal. The influence of the structure of several carbon and alloy steel specimens on this hardness increase and on the deformation was systematically investigated. The relative increase of the hardness was found to depend greatly on the original structure of the metal: austenitic steels exhibited the largest increase, perlitic and sorbitic steel the least. Plastic deformation induced by quenching from the martensitic structure also resulted in an increase of the hardness. Carbon steels presented a larger relative hardness increase than alloy steels. The increase of hardness induced by plastic deformation is connected with the dispersion of the sorbite. Although the relative hardness increase of sorbitic steels was slight, the plastic deformation treatment is usable for increasing the specific strength of the metal. (TTT)

3435 STRESS-RELIEVING AT HUNTERSTON. Nuclear Energy, 416-19(Oct. 1961).

Stress-relieving of the first 70 ft diameter reactor pressure vessel at Hunterston nuclear power station is described. In this operation about 1800 tons of steel situated at an average height of 85 ft above ground level is heated to a temperature of 550°C, soaked for 12 hours, and then allowed to cool slowly. A high degree of control is essential to prevent the temperature difference between any two points in the vessel exceeding a specified maximum. The radiant heating system for the operation is described. (N.W.R.)

3436 INVESTIGATION OF THE PROCESSES OF PRESSING AND HIGH-TEMPERATURE SINTERING OF ELECTROLYTIC POWDERS OF TANTALUM AND NIOBIUM. V. M. Amosov and V. V. Dianov. Poroshkovaya Met., No. 3, 14-19(May-June 1961). (In Russian)

A number of physicochemical properties of electrolytic powders of tantalum and niobium with a raised content of impurities were investigated in the process of pressing and high-temperature sintering in vacuum. The question of removing the impurities in the process of vacuum refining of tantalum and niobium is discussed. The results were used for developing production methods of obtaining plastic tantalum and niobium from electrolytic powders. (auth)

3437 IMPROVEMENTS IN THE MANUFACTURE OF METALLIC RESERVOIRS. (to Compagnie Francaise D'Entreprises). British Patent 877,792. Sept. 20, 1961.

A method is given for manufacturing a large metal container of spherical or ovoid shape which has a thickness on the order of 50 to 200 mm and is suitable for use for containing an atomic reactor. The method comprises the steps of forming an inner shell and superposing a series of outer layers thereon, each layer being formed by plates welded to the shell or preceding layer and being thinner than the inner shell. Thus, a thick container is obtained which retains the flexing properties of the individual plates or sheets. (D.L.C.)

3438 IMPROVEMENTS IN METHODS OF MANUFACTURING POROUS BARRIERS. (to Commissariat a l'Energie Atomique). British Patent 883,760. Dec. 6, 1961.

A method is outlined for manufacturing porous barriers having a very large number of very small pores for isotopic separation applications. The method comprises mixing an organic binder, preferably thixotropic, with a powdered metal oxide, shaping the resulting paste, and carrying out a light sintering treatment on the shaped part in such a manner that welding together of the grains just commences, giving a barrier with a pore radius ranging from ~0.5 to 0.75 of the grain radius. (D.L.C.)

3439 IMPROVEMENTS IN OR RELATING TO THE FABRICATION OF BERYLLIUM. William Munro and Nigel Austin Hill (to United Kingdom Atomic Energy Authority). British Patent 884,108. Dec. 6, 1961.

A method is given for production of beryllium tubing with good ductility at right angles to the extrusion direction. The method comprises boring out a central hole in an extruded beryllium rod to form a billet, and then extruding the billet to give a reduction in cross-sectional area of not more than 15 to 1. The billet may conveniently be extruded to form a tube of the same internal diameter as that of the billet, but of reduced external diameter. This method results in a considerable saving in material as compared with boring out a rod without subsequent extrusion. (D.L.C.)

3440 SURFACE TREATMENT OF MOLYBDENUM METAL. Charles O. Coffer (to U. S. Atomic Energy Commission). U. S. Patent 3,011, 923. Dec. 5, 1961.

A process of descaling molybdenum articles comprises first immersing them in an aqueous sodium hydroxide–potassium permanganate solution of between 60 and 85°C, rinsing, and then immersing them in an aqueous solution containing a mixture of sulfuric, hydrochloric, and chromic acids.

Properties and Structure

Refer also to abstract 3846

3441 (ANL-6426) ELECTRICAL PROPERTIES OF GLASS. A BIBLIOGRAPHY. Robert Kepple (Argonne National Lab., Ill.). July 1961. Contract W-31-109-eng-38. 37p.

A bibliography on the electrical properties of glass is presented. The 267 references covering the period from 1930 through 1960 are arranged according to subject. An author index is included. (M.C.G.)

3442 (ARF-2212-2) DEVELOPMENT OF DUCTILE BERYLLIUM COMPOSITES. Bimonthly Report No. 2, March 18, 1961–May 17, 1961. Frank A. Crossley (Illinois Inst. of Tech., Chicago. Armour Research Foundation). May 17, 1961. Contract NOw-61-0370-c. 8p. (AD-258089).

Further efforts to produce ductile beryllium composites consisting of beryllium particles in a ductile matrix are reported. A number of composites were tested in uniaxial compression in order to determine the matrix composition and heat treatment for the best mechanical properties. Silver-base matrices containing 6, 7, and 8% aluminum were evaluated. The best results were obtained for the Ag–6Al matrix suggesting that Ag–5Al be evaluated. A $\frac{3}{4}$ in. diameter compact (Ag–6Al matrix) was canned in copper and successfully extruded at 500°C with a reduction ratio of 2.5:1. (auth)

3443 (ASD-TR-61-3) INVESTIGATION OF TUNGSTEN–TANTALUM–COLUMBIUM-BASE ALLOYS. Period Covered: March 15, 1960 to December 31, 1960. Charles R. McKinsey, A. Leslie Mincher, Wallace F. Sheely, and Jack L. Wilson (Union Carbide Metals Co., Niagara Falls, N. Y.). Mar. 1961. Contract AF33(616)-7225. 135p.

Two categories of properties pertaining to selected refractory alloy systems are presented. The alloys were screened as to their usefulness as high-temperature structural materials. Measurements of hot-hardness and oxidation resistance of arc-cast specimens delineated areas within the tungsten–tantalum–niobium ternary systems combining high hardness at temperatures up to 2900°F with improved oxidation resistance at 2190°F. The addition of tungsten and titanium was found to improve the oxidation resistance of tantalum at 1830 and 2190°F, probably because of the formation of complex oxides in the outer scale. The second area of investigation was concerned with mechanical properties of tungsten or niobium at low and intermediate temperatures. The low-temperature yield properties of tungsten were studied, employing a compression test. Static strain-aging of tungsten at 400 to 600°C was attributed to hydrogen. Dynamic strain-aging of niobium-oxygen systems occurred at 300 to 400°C, while the addition of titanium, zirconium, and vanadium to niobium was found to shift the strain-aging region to 700 to 800°C. (auth)

3444 (ASD-TR-61-182) SURFACE AND ENVIRONMENTAL EFFECTS ON CERAMIC MATERIALS. P. Gibbs G. S. Baker, B. Gale Dick, Jr., E. K. Beauchamp, M. H. Miles, and W. G. Rogers (Utah. Univ., Salt Lake City). May 1961. Contract AF33(616)-6832. 27p.

Polycrystalline sintered compacts of Alucer MC alumina doped with MgO or $Mg(CO_3)_2$ were deformed in three point beam loading in the temperature range of 1000° to 1350°C. It is suggested that polycrystalline creep is controlled by diffusion of vacancies in the steady state. Creep behavior of Linde corundum 0.1 inch diameter rods in three point loading (1000° to 1250°C) is described. At the lowest temperatures and stresses studied, measurable creep began after about an hour's time delay, and increased at an accelerating rate. A study is described of the dispersal of impurities from a metal contact over the free surface of corundum at 10^{-4} mm Hg, by measuring the current flowing between two vacuum deposited Ag films as a function of time, temperature (20° to 640°C), and applied field (0 to 12 v). It is suggested that detaching Ag from the deposited film controls the rate of formation of a semiconducting bridge on or just beneath the corundum free surface. (auth)

3445 (ASD-TR-61-193) EXTRUSION AND MECHANICAL PROPERTIES OF SOME MOLYBDENUM- AND TUNGSTEN-BASE ALLOYS. M. Semchyshen and Robert Q. Barr (Climax Molybdenum Co. of Michigan, Detroit). Mar. 15, 1961. Contract AF33(616)-6929. 117p.

Successful extrusion techniques have been developed for several Mo-base alloys, W-Mo binary alloys, and for unalloyed W. Successful extrusions were performed at temperatures from 2000 to 3200°F, and at reduction ratios from 4:1 to 8:1. The use of ceramic (Al_2O_3)-faced extrusion dies was found to reduce the resistance to extrusion and to improve the recovery of sound stock. Many of the extruded bars were successfully converted to bar stock by rolling at 2400°F. Excellent high-temperature tensile and creep-rupture strengths were displayed by several of the alloys. Strengths of binary alloys of W with 10, 30, or 50% Mo were below those of the better Mo-base alloys at test temperature of 2400°F and below. A relationship is proposed to describe the effect of exposure time on the recrystallization behavior of unalloyed Mo, Mo + 0.50% Ti, Mo + 0.059% Zr, and Mo + 0.49% Ti + 0.057% Zr. The effect of externally applied stresses on the recrystallization behavior of these materials is also treated. (auth)

3446 (ASD-TR-61-216) PRESENTATION OF CREEP DATA FOR DESIGN PURPOSES. M. N. Aarnes and M. M. Tuttle (Boeing Airplane Co., Seattle). June 1961. Contract AF33(616)-7201. 169p.

This program was conducted to obtain additional and comparative creep data, to compare creep data from several sources, and to recommend what values to present and in what form to present creep data for design purposes. Conventional long time creep tests were performed on A-286 at 1200 and 1500°F; ALLOAT at 800 and 1000°F; and Unimach 2 at 600 and 900°F for purposes of comparing with existing similar data. Conventional creep tests were performed on René 41 at 1250, 1400, 1550, 1700, 1850, and 2000°F. Data were analyzed and are presented in the form of activation series equations. Nomographs were derived for each material. Cyclic creep tests were performed on René 41, in which both stress and temperature were cycled. Cyclic data were found to be comparable to the constant stress constant temperature data. (auth)

3447 (ASD-TR-61-360) THERMODYNAMIC PROPERTIES OF 20.4°K-EQUILIBRIUM HYDROGEN. A. Shaffer and J. Rousseau (AiResearch Mfg. Co., Los Angeles). July 1961. Contract AF33(616)-7895. 49p.

The thermodynamic properties are presented of 20.4°K-equilibrium hydrogen for pressures between 1 and 3000 psia and temperatures between 25 and 5000°R. Several graphical representations of the data are given. These consists of temperature-entropy, enthalpy-entropy, pressure-enthalpy, temperature-enthalpy, and temperature-density diagrams. Data are given to show the effect of ortho-para composition on hydrogen properties. High-temperature gas properties shown include the effects of dissociation and non-ideal gas behavior. (auth)

3448 (ASD-TR-61-516) STATISTICAL EVALUATION OF RENÉ 41 TENSILE PROPERTIES. Donald P. Moon, Glenn H. Beatty, and Ronald J. Favor (Battelle Memorial Inst., Columbus, Ohio). Aug. 31, 1961. Contract AF33(616)-6410. 44p.

Results of routine acceptance tests at room temperature and at 1400°F showed that the variation in tensile strength, yield strength, and ductility among heat-treated René 41 sheet specimens from a given sheet often exceeded that resulting from the combined effects attributable to producer, thickness, and heat. The distribution of strength properties was not normal in the tails; in particular, the frequency of values was higher than normal in the low-strength tail, from which design values are usually selected. This fact must be taken into account in selecting design values based on probability of failure. (auth)

3449 (BMI-1551) DIFFUSION COEFFICIENTS OF URANIUM AND CARBON IN URANIUM MONOCARBIDE. Walston Chubb, Charles W. Townley, and Ralph W. Getz (Battelle Memorial Inst., Columbus, Ohio). Nov. 6, 1961. Contract W-7405-eng-92. 28p.

The rates of diffusion of carbon-14 in uranium monocarbide are described by the equation, $D_c = 0.02 \exp(-50{,}000/RT)$, over the temperature range, 1200 to 2000°C. The rates of diffusion of uranium-235 in uranium monocarbide are described by the equation, $D_u = 0.0013 \exp(-64{,}000/RT)$, over the temperature range, 1600 to 2100°C. Attempts to determine rates of interdiffusion in the uranium carbides formed between liquid uranium and graphite were frustrated by lack of a suitable analytical technique. The rates of growth of the monocarbide layer formed are described by the rate-process equation, $KD = X^2/t = 16.6 \exp(-71{,}300/RT)$, over the temperature range, 1200 to 2000°C. (auth)

3450 (BMI-X-178) DEVELOPMENT OF URANIUM MONONITRIDE. Quarterly Progress Report, July–September 1961. Donald L. Keller (Battelle Memorial Inst., Columbus, Ohio). Oct. 1, 1961. Work performed under United States-Euratom Joint Research and Development Program. Contract W-7405-eng-92. 11p. (EURAEC-169)

Calculated Wiedemann-Franz-Lorenz relations between the thermal and electrical conductivities of UN are given for temperatures of 200 to 800°C. Linear thermal expansion coefficient data are given for UN at 20 to 1600°C and fit the equation, $L_t = L_0 [1 + (7.1t + 0.0032t^2 - 0.86 \times 10^{-6} t^3) \times 10^{-6}]$. Measurements of the dynamic elastic modulus and hardness of UN are reported. Lattice constant values of UN are presented at varying oxygen and carbon contents. The irradiation program of UN samples is described. (D.L.C.)

3451 (CEA-1734) LES MÉCANISMES DE DÉFORMATION ET DE RECRISTALLISATION DES MONOCRISTAUX IMPARFAITS D'URANIUM (THESE). (The Mechanisms of Deformation and of Recrystallization of Imperfect Uranium Monocrystals (thesis)). Daniel Calais (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 76p.

Submitted to Univ. of Paris.

The various means by which plastic deformations by

slip, twinning, or kinking are produced by tension of imperfect α uranium single crystals prepared by a $\beta \rightarrow \alpha$ phase change were studied by x rays and micrographic examination. Depending on the crystallographic orientation with respect to the direction of the applied tension, and depending on the magnitude of the change in length, the crystals are deformed either preferentially according to a single mechanism, for example twinning, or simultaneously according to two or three mechanisms. The results of a subsequent annealing of the deformed single in the α phase are studied with respect to the deformation mechanisms. In the case of a deformation due primarily to (010) [100], (011) [100], or (110) [001] sliding, there occurs recrystallization by crystal growth selectivity. If the deformation occurs via deformation bands, there is recrystallization by oriented nucleation. The crystals deformed preponderantly by twinning give on recrystallization perfect crystals having optimum dimensions and having orientational characteristics closely related to those of the original crystal. Finally, some criteria relating to the geometry and the dynamics are discussed with a view to explaining the occurrence of such and such a deformation mechanism of a single crystal with a given orientation. This study, in conclusion, must help to define the best conditions (crystalline orientation and process of deformation) which will promote the growth of large, perfect, single crystals. (auth)

3452 (DMIC-Memo-139) REVIEW OF RECENT DEVELOPMENTS IN THE TECHNOLOGY OF TUNGSTEN. V. D. Barth (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Nov. 24, 1961. 11p.

Current developments in the technology of tungsten are reviewed. Topics discussed briefly include the development of a new procedure for making W sheet; the production of extruded W structural shapes for operation above 300°F; the effect of annealing temperature on doped and undoped W foils; the development of W felts made from matted W wire; the preparation of W alloys with Zr, Nb, Ti, and C; the growth of W and W alloy crystals; and the mechanical properties of a number of W alloys. (18 references.) (C.H.)

3453 (HW-60611) STABILITY OF PRESSURIZED TUBES DURING PRIMARY CREEP. K. R. Merckx (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 5, 1959. Contract AT(45-1)-1350. 2p.

An analysis was carried out on the primary creep rates in thin-walled pressure tubing, and unstable creep conditions are considered. Such instability affects the extrapolation of short-time creep rupture tests of materials having high initial deformation and significant primary creep. (D.L.C.)

3454 (HW-68253) DEVELOPMENT OF CORROSION-RESISTANT ALUMINUM ALLOYS FOR HIGH-TEMPERATURE WATER SERVICE. H. C. Bowen (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1961. Contract AT(45-1)-1350. 55p.

The variables which might affect the corrosion resistance of Al alloys in low-flow, high-temperature water were investigated. Results of a study to optimize these alloys for dynamic testing are included. It was found the low-Si alloys show excellent corrosion resistance at temperatures above 320°C. There appears to be no single optimum Ni–Fe content and the Al–Fe–Ni alloys are sensitive to fabrication variables. The uniform penetration of the alloys was found to increase with water temperature to a maximum at 320 to 350° then decreases with temperature rise. (J.R.D.)

3455 (HW-69678) RECOVERY AND RECRYSTALLIZATION OF ZIRCONIUM AND ITS ALLOYS. PART 1. SPECIMEN COMPOSITIONS, COLD WORKING, HEAT TREATMENT, AND SURVEY OF THE LITERATURE. S. H. Bush, R. S. Kemper, and D. L. Gray (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 1961. Contract AT(45-1)-1350. 46p.

Zirconium, Zircaloy-2, vacuum-melted Zircaloy-3, and argon-melted Zircaloy-3 were cold worked to levels of 10, 25, and 50% preparatory to conducting recovery and recrystallization annealing studies. A uniform penultimate grain size was established for each material prior to cold working. Annealing studies were made in three atmospheres, air, helium, and vacuum, to establish the effect of contamination on properties. The results of Rockwell G hardness and electrical resistivity measurements are reported on the cold-worked material as are corrosion tests in 360°C water. An extensive survey of the literature dealing with recovery and recrystallization is presented with particular emphasis on zirconium and zirconium alloys. (auth)

3456 (HW-70612) EFFECT OF LOW HYDROGEN CONCENTRATIONS ON HALL EFFECT IN ZIRCALOY-2. W. G. Magnuson, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 1, 1961. Contract AT(45-1)-1350. 12p.

The effect of low hydrogen concentrations on Hall effect measurements in Zircaloy-2 was investigated using an alternating current method. Hall coefficient measurements were made at room temperature at hydrogen concentrations from 0 to 15,000 ppm (by weight) in magnetic fields up to 4750 gauss. The Hall coefficient was found to have a nonmonotonic relationship with hydrogen content at concentrations to 1000 ppm. It was found that from 5000 to 15,000 ppm, the relationship between Hall coefficient and hydrogen content is linear. (auth)

3457 (MATT-99) ELECTRICAL CONDUCTIVITY OF FUSED SALTS. E. F. Johnson and F. W. Pardee, III (Princeton Univ., N. J. Plasma Physics Lab.). Aug. 1961. Contract AT(30-1)-1238. 54p.

On the basis of experimental data on the pure fused alkali chlorides, bromides, and iodides and a theoretical treatment of electrical conductivity using the hole theory of the liquid state, a tabulation of individual equivalent ionic conductivities was devised. These conductivities depend on the size and mass of the ions. By adding the appropriate ionic conductivities for a given fused salt and making a modification for interaction effects, it is possible to estimate the conductivity of the salt within ±20% over wide temperature ranges. (D.L.C.)

3458 (NP-11055) THE INFLUENCE OF SURFACE CONDITION AND CHEMICAL ENVIRONMENT ON DEFORMATION AND FRACTURE PROCESSES IN CERAMICS. Progress Report No. 6. R. F. Schneidmiller, J. F. Young, and J. K. Okumura (Douglas Aircraft Co., Inc., Santa Monica, Calif.). Nov. 15, 1961. Contract AF33(616)-7315. 10p.

Optical absorption studies were conducted on MgO crystals at 650 to 1200°C to determine the cause of the brown coloration occurring during slow cooling more often than during quenching. The coloration was concluded to result from the formation of ferric oxide from ferrous oxide, and was found to increase with decreasing temperatures down to 650°C. Isotopic studies of phosphate conversion coatings indicated poor reproducibility for formation of the coatings, resulting in minimum coatings after six minutes of polishing of 0.025 mm and a maximum coating of 0.5 mm. Studies were initiated in the use of thermal decoration in the study of cleavage dislocations. (B.O.G.)

3459 (NP-11069) OXIDATION RESISTANT HIGH TEMPERATURE PROTECTIVE COATINGS FOR TUNG-

STEN. Second Quarterly Progress Report, August 1, 1961–October 31, 1961. H. J. Nolting and R. H. Burgess (TAPCO. Div. of Thompson Ramo Wooldridge Inc., Cleveland). Nov. 15, 1961. Contract AF33(616)-8188. (TM-3159-67)

An investigation was made of the formation and protective nature of metal bonded-metal modified oxide ceramic coating systems for tungsten. Studies were made of the vacuum pack deposition of titanium, zirconium, yttrium, and silicon to form metallic alloy surface layers on tungsten and of conversion of these metallic surface layers to metal modified oxides, which on exposure to air at temperatures above 2800°F formed dense, gas-tight oxide ceramic coatings. Coated tungsten specimens were cyclic oxidation tested in air at 2800°, 3000°, and 3200°F. Protection of tungsten from oxidation for 2.5 hours at 3200°F with six thermal cycles to room temperature was achieved. A discussion is presented of the design and operation of a high-temperature air oxidation furnace. (auth)

3460 (NP-11108) MECHANICAL, OXIDATION, AND THERMAL PROPERTY DATA FOR SEVEN REFRACTORY METALS AND THEIR ALLOYS. Final Report. T. E. Tietz and J. W. Wilson (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Sept. 15, 1961. Contract NOas-60-6119-c. 315p.

Property data for Cr, Nb, Mo, Re, Ta, W, and V are presented in detail. The figures presented are intended to serve only as a general guide, as the properties are sensitive to variations in impurities, fabrication history, thermal treatments, and specific test conditions. Details regarding the known effects of these variables are discussed. The melting point, crystal structure, and density of the seven refractory metals are summarized in tabular form. The mechanical, oxidation, and thermal properties of these metals and/or their alloys are summarized from comparable data presented for each metal. (auth)

3461 (NP-11125) CONFERENCE ON COORDINATED BASIC RESEARCH ON THE MILITARY THEME: CERAMICS FOR STRUCTURAL USE. (Army Research Office, Durham, N. C.). Sept. 12, 1961. 16p.

Summaries are given of the 6 papers presented at the Conference on Coordinated Basic Research on the Military Theme: Ceramics for structural use. Topics covered include mechanical properties of polycrystalline ceramics, slip processes in fine-grained polycrystalline spinel ($MgAl_2O_4$), mechanical characteristics of polycrystalline NiO, plastic properties of cubic crystals in the transition from single crystal to polycrystalline state, elastic and anelastic properties of cubic crystals and fine-grained dense polycrystalline compacts, and strength of structural ceramics under impact loading. (M.C.G.)

3462 (ORO-461) THE TRUE STRESS-STRAIN PROPERTIES OF BRITTLE MATERIALS TO 5000°F. Final Report. (Southern Research Inst., Birmingham, Ala.). July 28, 1961. Contract AT(40-1)-2694. 99p.

Design and development of a facility to determine the tensile strength and moduli of brittle materials at 5200°F are described. Data obtained on several types of specimens are presented. All components of the facility were tested and the characteristics of the complete facility are considered. (J.R.D.)

3463 (ORO-502) CHARACTERIZATION OF UO_2 POWDERS. Second Quarterly Report, January 10, 1961–April 10, 1961. James F. Carpenter and Carl W. Kuhlman (United Nuclear Corp. Chemicals Div., Hematite, Mo.). Contract AT(40-1)-2699. 26p.

Studies were conducted to determine the relationships between the physical and chemical properties of UO_2 powders and their ceramic behavior. It was found that, in general, high sintered density pellets were produced from powders having high surface area, small agglomerate and particle size, high O:U ratio, and low bulk and tap densities. Prolonged ball milling was found to result in reduction of agglomerate size and bulk density, increased O:U ratios, increased surface areas, and improved sinterability for oxides which sintered poorly before milling. The improvement of ceramic performance from milling and increased green pressing pressures came from a decrease in the open porosity in the fired pellets. (D.L.C.)

3464 (PWAC-359) SOLID-STATE METALLURGY STUDIES OF PURE COLUMBIUM AND Cb-1 Zr ALLOY. D. P. Gregory and G. H. Rowe (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). June 30, 1961. Contract AT(11-1)-229. 35p.

Dislocations in pure Nb and Nb-1 Zr alloy were studied by means of creep, strain rate, surface slip marking, and transmission electron microscopy tests. Test results showed that dislocations in Nb and Nb-1 Zr alloy cross slip easily, that slip is propagated across grain boundaries, that a strength advantage of 300°F for the one percent zirconium alloy over pure Nb is partially the result of dislocation-precipitate interactions, and that the aging reaction in Nb-1 Zr alloy is also the result of dislocation-precipitate interactions. Lattice vacancies produced during neutron irradiation are important in determining the strength of the niobium alloy during irradiation. Properties of lattice vacancies produced by room temperature plastic deformation in pure Nb were studied by means of electrical resistivity measurements during anneals above room temperature. The critical temperature for vacancies during a one hour anneal was found to be approximately 165°C. Assuming the energy to move lattice vacancies in Nb is 23,100 cal/mole, the number of jumps a vacancy makes to an annihilation site is calculated as 6.3×10^4. If dislocations are the principal annihilation sites, this gives a dislocation density of 5.3×10^9. Assuming Seitz's equation for the concentration of strain-produced vacancies is correct, the resistivity contribution of one atomic percent of vacancies in Nb is 30×10^{-8} ohm-cm. A strain of 0.25 percent produces a concentration of strain-produced vacancies equal to the thermal concentration in equilibrium at the melting point of Nb. This strain is 72 times smaller than that required to produce the same result in copper. Since vacancies are mobile in Nb during straining at temperatures greater than 165°C, annihilation of vacancies occurs during straining at higher temperatures. Calculations show that steady-state is not achieved during a normal tensile test at 300°C, while equilibrium is probably established during a tensile test at 1000°C. (auth)

3465 (RADC-TN-61-39) SEMICONDUCTIVE PROPERTIES OF CdS. FORMING, ELECTRON ACTIVATION ENERGIE, HALL EFFECT. Technical Notes No. 1, September 1958–August 1960. A. Luyckx, J. Vandewauwer, and Paul Coopmans (Louvain, Belgium. Université). Contract AF61(052)-166. 63p. (AD-257345)

Measurements and calculations were carried out for Hall effect, number of electron carriers, mobility, and energy of activation of electrons for extrinsic and intrinsic conduction of several CdS single crystals activated with In, Ga, Ag. These measurements became possible with a good accuracy only after forming with high frequency. Comparison was done between this forming and the well known heating in argon at 850°C. Hall effect measurements were reproducible and gave straight lines with variation of mag-

netic field or current. Experiments showed that this forming was a volume effect although there was also a surface effect on contact. Extrinsic conduction of CdS, Ag, and In can be represented by formula $i = AT^x \exp - (E)/(2kt)$ where $x = 2$. Energy of activation was 0.00384 ev for CdS, Ag, In, and contacts of Sn. For intrinsic conduction no reproducible results were found. Straight lines for log σ are broken. (auth)

3466 (SCDR-38-61) TENSILE TESTS ON 304 ELC STAINLESS STEEL. J. D. Huntting (Sandia Corp. Livermore Lab., Livermore, Calif.). 1961. Contract [AT(29-1)-789]. 11p.

304 ELC stainless steel tubing was tested to determine properties of the material when it is worked. Results indicate a yield point of about 27,500 psi and an ultimate strength of 80,000 psi, with unit elongation ranging from 52 to 67% depending on the type of loading applied. (auth)

3467 (TID-7602(Pt.1)(Rev.)) PROCEEDINGS OF THE BERYLLIUM OXIDE MEETING HELD AT OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, TENNESSEE, DECEMBER 1-2, 1960. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. 43p.

Five papers presented at the Beryllium Oxide Meeting held at ORNL are given. Separate abstracts were prepared for each paper. (M.C.G.)

3468 (TID-7602(Pt.1)(Rev.)(p.1-11)) FABRICATION DEVELOPMENT OF BERYLLIUM OXIDE–URANIUM DIOXIDE CERAMIC FUEL AT AEROJET-GENERAL NUCLEONICS. J. F. Ward and C. W. Funk (Aerojet-General Nucleonics, San Ramon, Calif.).

A seven-stage process was developed to prepare UO_2 and BeO powder as ceramic fuel pellets. Approximately 97,000 pellets were fabricated successfully to tolerance dimensions of ±0.002 in. in diameter and within 2% of required density. An empirical relationship was developed between shrinkage and the ratio of green and fired density of the ceramic pellets. Variations of impurities and particle size of BeO produced variable sintering characteristics. (M.C.G.)

3469 (TID-7602(Pt.1)(Rev.)(p.12-16)) IRRADIATION TESTING OF BERYLLIUM OXIDE–URANIUM DIOXIDE BODIES AT BATTELLE. John E. Gates (Battelle Memorial Inst., Columbus, Ohio).

Two experiments were completed involving the irradiation of BeO fueled with UO_2. In general, the fueled BeO pellets withstood the described irradiations without any apparently detrimental effects. No visible deterioration of the pellets was observed either by visual or metallographic examination. Comparison of pre- and postirradiation dimensional measurements revealed that no measurable swelling had occurred in the pellets. However, it was possible to detect decreases in density of about 1.0 to 2.4%. Only small amounts of fission gas, approximately equal to the amounts of gas theoretically released by recoil, were released from the specimens during irradiation. (M.C.G.)

3470 (TID-7602(Pt.1)(Rev.)(p.17-26)) THE IRRADIATION TESTING OF BERYLLIUM OXIDE–URANIUM DIOXIDE FUEL PELLETS BY GENERAL ATOMIC. Dale E. Johnson and J. Martin Tobin (General Atomic Div., General Dynamics Corp., San Diego, Calif.).

Results are presented on irradiation tests of BeO-UO_2 fuel pellets. The burnup was estimated from heat transfer and monitor wire data to be in the range of 38,000 to 46,000 Mwd/ton U. Dimensional data for the pellets did not reveal any significant change that could be attributed to irradiation. Photomicrographs were made to show the grain structure. The crushing strength of both irradiated and unirradiated pellets was measured. The compressive strength was reduced during irradiation. (M.C.G.)

3471 (TID-7602(Pt.1)(Rev.)(p.27-8)) BERYLLIUM OXIDE WORK AT LOS ALAMOS SCIENTIFIC LABORATORY. J. R. Hopkins (Los Alamos Scientific Lab., N. Mex.).

Work is being carried out on the possible use of BeO in a high-temperature plasma thermocouple reactor as a tube to form a gas-tight envelope for beryllium metal collectors. Research is being carried out on properties necessary for this application. (M.C.G.)

3472 (TID-7602(Pt.1)(Rev.)(p.29-37)) RESEARCH ON BERYLLIUM OXIDE AND FUELED BERYLLIUM OXIDE AT THE OAK RIDGE NATIONAL LABORATORY. W. O. Harms (Oak Ridge National Lab., Tenn.).

Research and development work on BeO and fueled BeO is described. Preparation of high-purity BeO and BeO-coated UO_2, calcination and sintering studies, incorporation of boron in dense BeO bodies, phase relations in BeO-metal oxide systems, irradiation of BeO, and fabrication of fueled BeO are discussed. (M.C.G.)

3473 (TID-14311) ON STEADY STATE PHASE TRANSFORMATIONS. Che-Yu Li and H. W. Weart (Cornell Univ., Ithaca, N. Y. School of Chemical and Metallurgical Engineering). Nov. 20, 1961. Contract AT(30-1)-2558. 16p.

The thermodynamics of irreversible processes was used to establish a relation between transformation velocity, v, and the dimension, S, of individual phase particles in the product structure. This relation Sv = constant was obtained by applying the principle of minimum entropy production to the steady state of an idealized diffusion-controlled transformation, subject to a mass balance constraint. Comparison with recent experimental data revealed severe limitations on the domain of the simple concept of the steady state used in the analysis. (auth)

3474 (USBM-U-863) QUARTERLY METALLURGICAL PROGRESS REPORT NO. 12, JULY 1, 1961–SEPTEMBER 30, 1961. (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Contract AT(11-1)-599. 19p.

The hafnium–tantalum phase diagram was completed. All alloys containing 30 to 80% tantalum were single phase above 1600°C. Investigation of the gadolinium–stainless steel system was confined to determining certain fabrication qualities and an electron-microprobe x-ray spectrographic analysis of eight specimens. A study of the effects of alloying Sm, Eu, Gd, Eb, and Dy with V, Cr, Al, Mn, and Cu was started. The effects of carbon, oxygen, and nitrogen on Nb–Ta weld embrittlement study was completed. The effects of these impurities are not additive. The transformation point for hafnium was determined to be 1775 ± 11°C. The production of alloys of gadolinium oxide and metallic niobium by powder metallurgy techniques is being studied. One compact containing 83% niobium and 17% gadolinium oxide exhibited some ductility. A confined working area was provided for studying thorium alloys and a supply of thorium, ytterbium, and praseodymium was obtained. Over 80% of the theoretical amount of hafnium and zirconium was extracted as the double fluorides (K_2HfF_6 and K_2ZrF_6) from the sintered products formed by the reaction of zircon concentrate with potassium silicofluoride. The solubilities of K_2HfH_6 and of K_2ZrF_6 were found to increase as the temperatures and the acidities of the solutions were increased. Equipment has been assembled for thermodynamic studies of melting. The hardness of hafnium decreased with in-

creased duration of electron-beam melting time and with decreased pressure. The rate of elimination of iron, aluminum, and titanium appeared to be related to their vapor pressures. The loss of carbon from stoichiometric mixtures of hafnium carbides during melting is being investigated. The loss is not consistent. (auth)

3475 (WADC-TR-59-603(Pt.II)) FRICTION AND WEAR AT ELEVATED TEMPERATURES. Ernest Rabinowicz and Masaya Imai (Massachusetts Inst. of Tech., Cambridge. Lubrication Lab.). Mar. 15, 1961. Contract AF33(616)-5963. 30p.

Friction experiments in the range room temperature to 1800°F were carried out on a wide variety of materials. Many of the results fall into no particular pattern, but tests involving boron carbide show a sharp peak in the friction-temperature plot. This is traced to the influence of boric oxide formed by oxidation. Studies of the properties of boric oxide suggest that it may be a useful boundary lubricant at elevated temperatures. (auth)

3476 (WADC-TR-59-744(Vol.VI)) INVESTIGATION OF FEASIBILITY OF UTILIZING AVAILABLE HEAT-RESISTANT MATERIALS FOR HYPERSONIC LEADING-EDGE APPLICATIONS. VOLUME VI. DETERMINATION AND DESIGN APPLICATION OF MECHANICAL PROPERTIES OF BARE AND COATED GRAPHITE. Alfred Rudnick, Robert L. Carlson, and George K. Manning (Battelle Memorial Inst., Columbus, Ohio). Oct. 1960. Contract AF33(616)-6034. 213p. (AD-257731)

The feasibility of utilizing available heat-resistant materials in the fabrication of leading edges for hypersonic boost-glide vehicles was investigated. The results of a study on the mechanical properties of a siliconized Grade ATJ graphite are presented. The mechanical properties were studied as functions of temperature (to 2950°F), strain rate, size, and stress state. Supplementary studies were conducted to determine the room-temperature properties of the uncoated material and the degree of anisotropy of both the coated and uncoated material. Gross variations in the material tended to obscure the effects of the parameters under consideration. Inspection techniques were developed, however, which will reduce these variations. With proper selection of materia! quality, it is believed that at the siliconized Grade ATJ, graphite can be used effectively as a structural component at elevated temperature in an oxidizing atmosphere. (auth)

3477 (WADD-TR-59-366(Pt.III)) THERMAL PROTECTION OF STRUCTURAL, PROPULSION, AND TEMPERATURE-SENSITIVE MATERIALS FOR HYPERSONIC AND SPACE FLIGHT. PART III. ANALYTICAL STUDIES OF PHENOMENA FOR THERMAL PROTECTION. William P. Manos and Donald E. Taylor (Chicago. Univ. Labs. for Applied Science). Dec. 5, 1960. Contract AF33(616)-6006. 183p.

The results are presented of both analytical and experimental investigations of the applicability of the mass transfer cooling phenomenon to the protection of materials subjected to severe thermal environments. Efforts to improve characterization of the experimental thermal environment provided by the one-megawatt air-stabilized arc are summarized. These efforts include extended development of calorimetry to provide measurement of heat flux rates at surface temperatures in excess of 3000°F and utilization of additional techniques for spectroscopic temperature determination. (auth)

3478 (WADD-TR-60-37(Pt.II)) PHYSICAL METALLURGY OF TUNGSTEN AND TUNGSTEN BASE ALLOYS. Period covered: February 1, 1960 through January 31, 1961. Heinz G. Sell, George H. Keith, Ronald C. Koo, Randolph H. Schnitzel, and Richard Corth (Westinghouse Electric Corp. Lamp Div., Bloomfield, N. J.). May 1961. 143p. Contract AF33(616)-6933.

Data on the metallurgical properties of pure tungsten for temperatures above 2500°F were obtained. The mechanism of purification in tungsten during zone melting was studied. The flow and fracture characteristics of tungsten single crystals were investigated as functions of annealing temperature and annealing atmosphere. Internal friction measurements were carried out at 20 to 800°C on high purity and dosed polycrystalline tungsten wires and single crystals of tungsten. Internal friction damping peaks were tentatively identified to be due to carbon and oxygen. Methods of dosing interstitials into tungsten were explored. The mechanical properties of dispersed second-phase tungsten base alloys such as W–ThO_2, W–TaC and W–HfO_2 were studied at temperatures above 2500°F. The high temperature strength of the alloys W–ThO_2 and W–TaC was confirmed, and it was found that these alloys retain their margin of strength over that of pure tungsten even at 3000°F. A theoretical investigation of the elastic properties of tungsten and other b.c.c. metals in relationship to the ductile-brittle transition was initiated. (auth)

3479 (WADD-TR-61-181) SUBSTRUCTURE AND MECHANICAL PROPERTIES OF REFRACTORY METALS. B. S. Lement, D. A. Thomas, S. Weissmann, W. S. Owen, and P. B. Hirsch (Manufacturing Labs., Inc., Cambridge, Mass.). Apr. 1961. Contract AF33(616)-6838. 255p.

Quantitative results on the substructural characteristics of tungsten, molybdenum, tantalum, and columbium are being obtained through the coordinated programs of the five participating laboratories. Changes in subboundary spacing of worked materials have been measured microscopically as a function of annealing temperature, and corresponding changes in particle size and lattice strain have been obtained by Fourier analyses of diffraction-line shapes. Combined application of x-ray reflection microscopy, double-crystal diffractometry, and transmission electron microscopy to single-crystal and polycrystalline tungsten has revealed various orders of substructure in terms of size, disorientation, and dislocation arrays; and progressive alterations have been traced through the stages of recovery and recrystallization. Stacking faults and twins have now been found in tungsten and columbium after high-temperature annealing. The stacking faults are believed to result from a lowering of the stacking-fault energy by impurities. The origin of fibered structures in heavily-drawn b.c.c. wire is now better understood. The complex interfolding of the distorted grains and the formation of deformation bands produce an unexpectedly large number of boundary intercepts per unit of transverse distance. There is also a reduction in the amount of grain boundary area transverse to the fiber axis, which probably decreases the number of sites for the initiation of brittle fracture. An x-ray technique developed for rapid determination of stereographic pole figures is being applied to a detailed study of the deformation and annealing textures in tungsten strip. Correlations have been found between the substructural characteristics and the mechanical behavior. Recovery-annealing of worked molybdenum strip results in increased ductility which is associated with an increase in x-ray particle size term. Systematic studies on the role of interstitial impurities in tantalum and columbium have been initiated. Measurements of the lower yield stress as a function of grain diameter have confirmed Petch relationships; however, the lattice friction stress was found to be strongly dependent on temperature, impurity content and substruc-

ture. Since the substructural detail changes as the annealing temperature is raised to vary the grain size, this may account for the anomalous values of the Petch slope that have been reported previously. (auth)

3480 (WADD-TR-61-262) INVESTIGATION OF SINTERABLE OXIDE POWDERS AND CERAMICS MADE FROM THEM. C. Hyde and W. H. Duckworth (Battelle Memorial Inst., Columbus, Ohio). Mar. 1961. Contract AF33(616)-6238. 20p.

This program is concerned with the strength of nonporous monophase ceramics as a function of their microstructure, and with the basic nature of sinterable powders. Sinterable powders provide a convenient way to study a wide variety of microstructural effects without introducing variations in density or purity. MgO powders, prepared by calcining a high-purity basic magnesium carbonate, were studied as representative examples of sinterable powders. The temperature of calcination of the carbonate was found to have a critical effect on the density that could be obtained in sintered compacts of the oxide. The density of compacts of each calcine increased during sintering until a ceiling density was reached after which grain growth occurred without further densification. Ceiling densities of 97 to 98% of theoretical were attained. Sintering in various atmospheres or for extended periods did not affect the attainable density, but sintering in a moisture-free atmosphere reduced the temperature at which the ceiling density was reached. Indications were that sintering atmosphere affected grain growth. The work demonstrated the importance of controlling processing variables to assure uniformly reproducible specimens for strength measurements. (auth)

3481 (WAL-TR-375/1) DEVELOPMENT OF A POROUS METALLIC COMPOSITE MATERIAL. Final Technical Report. George H. Bischoff and Angelo H. Rosetti (Emerson and Cuming, Inc., Canton, Mass.). June 24, 1960. Contract DA-19-020-505-ORD-4971. 64p.

The feasibility of making a porous metallic composite by bonding hollow metal spheres was demonstrated. Methods were developed for making hollow metal spheres by metallizing the surface of ceramic and plastic spheres. Hollow glass microspheres in the 1.0 to 5.0 mil diameter range were metallized by electroless Cu, Ni, and Ag processes. The building up of a sufficient metal thickness on these microspheres for bonding into a porous metallic composite appears impractical. Hollow clay spheres and hollow alumina bubbles were metallized by both electroless processes and by electrolytic processes. Expanded polystyrene spheres were metallized by electrolytic processes. Heavy metal coatings of 1 to 5 mils thickness were electroplated on 137 mil diameter polystyrene spheres. The polystyrene was then completely removed by heating to 600 to 650°F. Nickel, Cu, and Ag were successfully electroplated to form hollow metal spheres by this process. These spheres were bonded with Sn, Ag solder, or through electroplated Ag to form porous metallic structures. Open structure polyurethane foam was electroplated with Cu and/or Ni to form a porous metallic material. (auth)

3482 (FTD-TT-61-160) CERTAIN PROBLEMS OF THERMAL STABILITY. M. Yu. Bal'shin and Shou-huai Tai (Tai Shou Huei). Translated from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk. Met. i Toplivo, No. 3, 73-6 (1961). 9p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 29741.

3483 (JPRS-8937(p.43-81)) A NEW DIRECTION FOR RESEARCH OF HEAT RESISTANT ALLOYS — IRON-TUNGSTEN-SILICON ALLOY SYSTEM. Translated from Wu Li Hsüeh Pao, 15: No. 2, 89-111(Feb. 1959).

Studies were made on the Fe-W-Si system. Strength of atomic binding in alloys, changes in alloy structures and the dynamic process of aging hardening, heat resistance of alloys, heat fatigue strength, research in oxidation characteristics of alloys, effects of protective coatings, physical properties of alloys, and wear resistance are discussed. (M.C.G.)

3484 (UCRL-Trans-728(L)) THE DETERMINATION OF OPTICAL CONSTANTS FROM LIGHT ABSORPTION MEASUREMENTS ON THIN METAL FILMS. C. F. Veenemans. Translated by George A. Condas (Univ. of California Lawrence Radiation Lab., Livermore) from Arch. neerl. sci., IIIA, 14: 84-117(1933). 33p.

The absorption of monochromatic light through a metal film on a solid transparent medium, is calculated as a function of the wavelength and film thickness. With the help of this resulting formula it is possible to determine the optical constants of a metal from the absorption measurements on at least two metal films of known thickness, graphically. The method developed here was applied for example to antimony films produced by evaporation. The absorption measurements were made with a Van Cittert-Monochromator and a combination of a vacuum thermoelement and a galvanometer while if necessary the galvanometer deflections were intensified by the thermo-relay of Moll and Burgen. The optical constants of antimony have been determined for the wavelengths between 6500 and 15,000 Å. There was found no thickness dependency of the optical constants of antimony. Absorption measurements on antimony films at −180°C gave at a wavelength of approximately 1μ, a measurable temperature dependency which increased with wavelength. The largest wavelength with which it was measured, was approximately 4μ. With the help of the developed method the temperature dependence of the optical constants, each separately was determined from these measurements. (auth)

3485 PHASE RELATIONS IN THE SOLID STATE IN THE $CaO-ZrO_2-TiO_2$ SYSTEM. A. Cocco and P. Virdis (Università, Trieste, Italy and Università, Cagliari, Italy). Chim., e ind. (Milan), 43: 1115-21(Oct. 1961). (In Italian)

Investigation by reflected light and x rays were made of the 1400 and 1600°C isotherms of $CaO-ZrO_2-TiO_2$. The diagrams show the existence of a CZT_2 compound, of four solid solution regions, ten two-phase regions, and six three-phase regions. The structural examination of the cubic solid solutions evidenced the possible substitution, in the fluoritic lattice, of Zr^{4+} with Ti^{4+} and a defective structure due to the existence of anionic vacancies. (auth)

3486 CONTINUOUS SOLID SOLUTIONS OF THE INTERMETALLICS Ti_3Al AND Ti_3Sn IN THE Ti-Al-Sn SYSTEM. I. I. Kornilov and T. T. Nartova (Baikov Inst. of Metallurgy, Academy of Sciences, SSSR). Doklady Akad. Nauk S.S.S.R., 140: 829-31(Oct. 1, 1961). (In Russian)

Thermal, microstructural and x-ray analyses, and also measurements of the electrical resistance and hardness were run on Ti-Al-Sn alloys prepared by fusion in an arc furnace having a non-consumable tungsten electrode in an argon atmosphere. Thermal analysis showed that at 1590 to 1615°C an alloy containing 40 to 80% Ti_3Sn (16 to 36% Sn) crystallizes as an eutectic mixture consisting of two phases: a β-solid solution in a Ti-Al system and a ternary δ-solid solution on a Ti_3Sn base. The eutectic point corresponds to 45% Ti_3Sn (~ 20 wt % Sn). The addition of Ti_3Sn to Ti_3Al decreases the $\alpha \rightleftharpoons \beta$ transition temperature from 1120°C for Ti_3Al to a minimum of 990° at 60% Ti_3Sn. A

microstructural analysis showed that the cast ingot consisted of a δ phase and a β + δ (α) eutectic. An alloy of the same composition (50% Ti_5Sn, 50% Ti_3Al) consisted of a single-phase, α (δ)-solid solution after annealing. An x-ray analyses of well-annealed alloys showed only a single set of lines corresponding either to α-titanium or to Ti_5Sn. The hardness and electrical resistance show maxima at 50 wt % Ti_5Sn in Ti_3Al-Ti_5Sn mixtures. (TTT)

3487 CONCENTRATION DEPENDENCE OF THE ELECTROTRANSPORT OF NICKEL–CHROMIUM ALLOY COMPONENTS. I. N. Frantsevich and M. D. Smolin (Academy of Sciences, Ukrainian SSR). Dopovidi Akad. Nauk Ukr. R.S.R., No. 7, 908-10(1961). (In Ukrainian)

The concentration dependence of the electrotransport of nickel–chromium alloy components was investigated in the concentration interval of 4.76–31.01 at. % chromium. The real charges of the chromium and nickel ions, and the sections of the dispersion of electrons and holes by these ions are estimated. (auth)

3488 CRYSTAL STRUCTURE OF THE COMPOUND $MgInCu_4$. M. Yu. Teslyuk and P. I. Krip'yakevich. (L'vov State Univ.). Dopovidi Akad. Nauk Ukr. R.S.R., No. 8, 1039-41(1961). (In Ukrainian)

An x-ray examination of the alloy $MgInCu_4$ showed that this alloy is a ternary compound with a structure of the $MgSnCu_4$ type (space group $F\bar{4}3m-T_d^2$; 4 Mg in 4(a), 4 In in 4(c), 16 Cu in 16(e) with x = 5/8); a = 7.059 ± 0,006 Å. (auth)

3489 TERNARY LAVES PHASE IN THE SYSTEM Mn–Co–Be. P. I. Kripyakevich (L'vov State Univ.). Dopovidi Akad. Nauk Ukr. R.S.R., No. 8, 1042-4(1961). (In Ukrainian)

A ternary Laves phase was found, $MnCo_{0.8}Be_{1.2}$ ($MgCu_2$ type, space group $Fd3m-O_h^7$, Mn in 8(a), Co and Be in 16(d); a = 6.20 Å). (auth)

3490 ZIRCONIUM ALLOYS FOR REACTORS. Mamoru Nishihara, et al. (Kobe Steel Works, Ltd., Japan). Genshiryoku Kōgyō, 6: No. 9, 11-19(Sept. 1960). (In Japanese)

The general characteristics of the reactor-grade Zr alloys are reviewed, including the physical properties of pure Zr and of the pertinent alloys, manufacturing processes of Zr sponge and of Zircaloy, electric arc welding methods for the pure metal and the ingot, hot and cold working, annealing and welding. The high temperature behavior of Zircaloy, Ozhennite and of other alloys and their resistance against pressurized water are described. The corrosive effects of special media such as CO_2 and uranyl sulfate solution are also discussed, together with spectrophotometric analytical methods. (18 references). (TTT)

3491 BRITTLE FRACTURE OF ALLOY STEEL. M. P. Braun, B. B. Vinokur, A. G. Geller, and A. I. Kondrashev. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 4, 43-9(July-Aug. 1961). (In Russian)

The tendency of an alloy to be subjected to brittle fracture depends greatly on the ratio of its resistance against plastic deformation to its resistance against fracture; the larger this ratio the less probable is the occurrence of brittle fracture. In view of experimental difficulties, notch sensitivity is used for evaluating these parameters. The tests indicated that Cr–Mn steels alloyed with strong carbide-forming elements have roughly the same tendency toward brittle fracture under stress concentration as Cr–Ni–Mo steels. The threshold value of Cr–Ni steels toward cold brittleness is at a relatively high temperature. As a result of testing a series of different steels, Cr–Ni–Mn steels are recommended in the place of Cr–Ni–Mo steels for the fabrication of components of complicated machinery. This replacement would also result in saving Mo metal. (TTT)

3492 INVESTIGATION OF THE ALLOYS IN THE TITANIUM–NIOBIUM SYSTEM. K. I. Shakhova and P. B. Budberg. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 4, 56-8(July-Aug. 1961). (In Russian)

In view of their unique properties Ti and Nb have found novel application in recent years. Ti and its alloys present the advantage of favorable mechanical and corrosion-resisting properties combined with relatively low specific weight while the low capture cross section of Nb indicates its usefulness in the atomic industry. In order to establish the properties of the Ti–Nb–Cr ternary system, the Ti–Nb binary was investigated in the range from 40 to 90% Nb. The mixtures were prepared in an arc furnace with W electrodes, soaking them at 1500°C for 6 hours at a vacuum of 10^{-4} mm of Hg. X-ray-diffraction studies showed only the lines of a phase containing β solid solutions in both annealed and quenched samples. It is concluded that the system consists of a continuous series of solid solutions without the presence of TiNb type metallic compounds. The solid solutions presented a volume-centered cubic lattice. (TTT)

3493 STUDY OF THE NIOBIUM–MOLYBDENUM–CHROMIUM SYSTEM. M. I. Zakharova and D. A. Prokoshkin. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 4, 59-67(July-Aug. 1961). (In Russian)

Isothermic sections of the Nb–Mo–Cr system and of the corresponding binary systems Nb–Cr, Mo–Cr, and Nb–Mo were studied on specimens quenched from 1200°C by metallographic, x-ray diffraction and hardness testing methods. The specimens were prepared in an arc furnace with W electrodes on a water-cooled plate under an Ar atmosphere. Results indicated a homogeneity region in the Nb–Cr system, corresponding to the intermetallic compound $NbCr_2$ at 62 to 68 atomic % of Cr. This region is extended to 11 atomic % Mo in the Nb–Mo–Cr system. At 1200°C the solubility of Cr in Nb is 11 atomic %; that of Nb in Cr 2 atomic %. In the ternary system an α(β) solid solution is formed with a large region of homogeneity near the Mo corner of the diagram. (TTT)

3494 THE EFFECT OF TANTALUM CARBIDE ON THE COMPOSITION AND THE PROPERTIES OF THE COBALT PHASE OF THE TITANIUM CARBIDE–TUNGSTEN CARBIDE–COBALT ALLOYS. R. V. Rybal'chenko, V. I. Tret'yakov, and I. N. Chaporova. Izvest. Akad. Nauk S.S.S.R., Otdel, Tekh. Nauk, Met. i Toplivo, No. 4, 83-9 (July-Aug. 1961). (In Russian)

In view of the absence of pertinent data in the literature, the cementing Co phase, i.e. the Co corner of the pseudo-ternary TiC–WC–Co and of the pseudoquaternary TiC–WC–TaC–Co systems was studied for establishing the effect of TaC additions on the TiC–WC solid solutions and on the Co phase of the TiC–WC–Co alloys. Powdered Co and powdered solid solutions of the carbides were used as starting materials. It was found that addition of TaC does not change the solubility of TiC–WC in Co neither with nor without the presence of free C; it results however in an increase by about 100°C of the melting point of the binary system Co + TiCWCTaC with respect to the Co + TiCWC system; there is also a 20 to 30°C increase in the presence of free C. Addition of TaC affects an increase of the hardness of the alloys from room temperature up to about 400° at which point the difference becomes negligible. This indicates that the cementing phase has more strength at that temperature interval. This effect is noted however, only with mixtures not containing free C. (TTT)

3495 STUDY OF THE ELECTRIC RESISTIVITY OF ZIRCONIUM. APPLICATION TO THE STUDY OF THE RECRYSTALLIZATION OF THE METAL AFTER WORK-HARDENING. INFLUENCE OF THE PURITY. L. Renucci, J. P. Langeron, and P. Lehr (Centre d'Etudes de Chimie Metallurgique, Vitry-sur-Seine, France). Mem. sci. rev. mét., 58: 699-715(Sept. 1961). (In French)

The resistivity of zirconium is studied at low temperatures and applied to the study of recrystallization and recovery after work-hardening for various grades of zirconium of different purities, among them metal treated by zone refining. In particular, the influence of oxygen and nitrogen contents on the resistivity of zirconium is analyzed. (auth)

3496 DETERMINATION OF EQUILIBRIUM DIAGRAMS BY DIFFUSION IN THE SOLID STATE. Y. Adda, M. Beyeler, A. Kirianenko, and F. Maurice (Centre d'Etudes Nucleaires, Saclay, France). Mem. sci. rev. mét., 58: 716-24(Sept. 1961). (In French)

Diffusion tests in the solid state are carried out for various binary systems: U-Ti, U-Ni, Al-Ni and others in a temperature range where several phases coexist. Some of the equilibrium diagrams are derived from concentration/penetration curves established by the electronic-probe microanalyzer. The advantages and drawbacks of this method are described and an attempt is made to explain the differences between the equilibrium diagrams determined by conventional methods and those determined by solid-state diffusion. (auth)

3497 NEW STEELS AND ALLOYS. N. M. Lapotyshkin (Bardin Central Scientific Research Inst. of Ferrous Metallurgy [USSR]). Metalloved. i Termicheskaya Obrabotka Metal., No. 9, 2-8(Sept. 1961). (In Russian)

Basic research work is in progress at this institute on the strength of metals which includes research on dislocation phenomena, making use of electron microscopy and x-ray diffraction, and on the strength of acicular crystals with near-theoretic strength. An attempt was made to correlate strength and fine structure of alloys, paying special attention to the effects of diffusion. These studies indicated that addition of Mo lowers the surface energy of alloys. It was established that under elevated pressures new phases may be formed in metallic systems, providing a method for changing the kinetics of phase transformations. New steels have been developed with yield strengths exceeding 50 kg/mm^2; the new formulations also made it possible to achieve considerable savings in the Ni consumption during the fabrication of quality steels. Change of mechanical properties after irradiation in a reactor was studied; results indicate that the effects of radiation may cause a change in the orderliness of the system; this might be of great importance for developing alloys for use in radiation fields. The newly developed analytical methods include neutron diffraction which allows the preparation of neutronograms of single and polycrystalline materials in a magnetic field, and specialized activation analysis. (TTT)

3498 THE PROBLEM OF RARE-EARTH METALS. E. M. Savitskii (Metallurgical Inst., Academy of Sciences, USSR). Metalloved. i Termicheskaya Obrabotka Metal., No. 9, 19-33(Sept. 1961). (In Russian)

Recent achievements in the fields of space travel and nuclear technology are closely connected with the development of new metals, often containing hitherto unused components. The rare-earth metals, together with their analogs Y and Sc, were found to be very useful for modifying the physical properties of alloys. The new compounds found application in the machine construction industry, atomic technology, the chemical and the glass industry, etc. Currently attention is directed toward finding new sources of supply. The rare earths are poor conductors and at room temperature most of them are strongly paramagnetic. The isotopes Gd^{155}, Gd^{157}, Sm^{149}, Sm^{151}, and Eu^{155} have a high thermal neutron capture cross section and may be used as a nuclear poison; on the other hand Y has a low capture cross section of only 1.27 barn. Further attention must be directed toward the determination of phase diagrams of the elements and their compounds and alloys. (TTT)

3499 THE ROLE OF CRYSTALLINE PROPERTIES AND OF THE GRAIN SUBSTRUCTURE ON THE STRENGTH OF METALS. G. V. Kurdyumov and M. D. Perkas (Bardin Central Scientific Research Inst. of Ferrous Metallurgy, [USSR]). Metalloved. i Termicheskaya Obrabotka Metal., No. 9, 33-43(Sept. 1961). (In Russian)

The resistance of polycrystalline materials against deformation may be increased by impeding the propagation of plastic deformation in the metal. This may be achieved by decreasing the available cross section of the metal through the formation of subgrains as a result of cold plastic deformation or martensitic transformation; an alternate method consists in the increase of the resistance of the system to the migration of the dislocation by destroying the periodic character of the crystalline structure. The resistance depends on the presence of subgrains and sub-boundaries and on the degree of disorientation of neighboring regions. The effects of these factors are additive. The properties of the crystals may also be changed by introducing impurities and by creating disturbances in the system by irradiating or quenching the metal. The magnitude of the effect may be estimated from the variation of the yield strength. (TTT)

3500 THE STRENGTH OF ACICULAR CRYSTALS. I. A. Oding and I. M. Kop'ev (Metallurgical Inst., Academy of Sciences, [USSR]). Metalloved. i Termicheskaya Obrabotka Metal., No. 9, 44-9(Sept. 1961). (In Russian)

To investigate the metallic properties of "whiskers" which possess near-theoretical strength, their bending strength is usually measured. Literature data indicate that the strength of these needles decreases with increasing diameter and length; this is probably due to the effect of defects of various origin. Cu whiskers have axes with orientation in the [1 0 0], [1 1 0] or [1 1 1] directions; a cross section of a whisker with the axis in the [1 1 1] direction yields a hexagonal boundary while a [1 0 0] axis yields a square one. Whiskers with a diameter larger than 10 microns show a sudden decrease in strength. (TTT)

3501 OBSERVATION OF THE FRACTURE MECHANISM OF AUSTENITIC STEELS AT 1100°C AND SHORT PERIODS OF SERVICE LIFE. I. A. Oding, M. G. Lozinskii, E. I. Antipova, and V. N. Stepanov (Metallurgical Inst., Academy of Sciences, USSR and Mechanical Engineering Inst., Academy of Sciences, USSR). Metalloved. i Termicheskaya Obrabotka Metal., No. 10, 10-13(Oct. 1961). (In Russian)

Steel specimens, 18% Cr–9% Ni–1.56% Mn and 14% Cr–15% Ni–2.3% W, were subjected to breakage tests under constant load for periods ranging from 3 to 30 minutes. The fracturing was observed by means of a motion picture camera the speed of which was reduced to 12 to 120 frames per minute. After soaking the specimens at 1100° for 1 minute the original microstructure could be observed. Intergranular cracks were noted at an early stage of deformation. The total elongation to breakage under different loads ranged between 17 and 25% for the first specimen and 8 and 16% for the second; lower total deformation took place in specimens

with larger grain size. Under an identical load of 2.5 kg/mm^2 the first specimen was fractured after about 5.5 minutes, the second after 24 minutes. The effect of grain size is due to the fact that with increasing grain size the length of the brain boundaries is reduced. (TTT)

3502 THE EFFECT OF RARE-EARTH METALS ON THE PROPERTIES OF HEAT-RESISTANT Ni–Cr ALLOYS. T. V. Svistunova and G. V. Estulin (Bardin Central Scientific Research Inst. of Ferrous Metallurgy, [USSR]). Metalloved. i Termicheskaya Obrabotka Metal., No. 10, 13-16 (Oct. 1961). (In Russian)

Recent studies indicate that addition of small amount of rare earth metals to Co- and Ni-base heat-resistant alloys increases their long-life strength and their creep resistance. Instead of the formerly used mischmetal, pure Ce, La, Pr, and Nd were added individually to 75% Ni alloy, designated as EI437. It was found that the strength and the plasticity of the alloy were considerably increased during both short and long-term loading at 700°. The effect of the additions was found to be highest when the residual concentration of the addition does not exceed 0.02%. The degree of the effectiveness of the additions was a function of the melting point of the elements added. The improvement was most noticeable at high temperatures at which the mechanical properties of the alloy depend primarily on the state of the grain boundary. (TTT)

3503 THE EFFECT OF Ti, W, Mo AND Si ADDITIONS ON THE PROPERTIES OF CHROMIUM STEEL. V. G. D'yakov (State Inst. for the Design and Planning of Oil Equipment, [USSR]). Metalloved. i Termicheskaya Obrabotka Metal., No. 10, 17-20(Oct. 1961). (In Russian)

Four experimental steel specimens, containing 6.9 to 8% Cr and special additives of Ti, W, Mo, or Si, were tested for the purpose of developing corrosion-resistant tubes for use in heat exchangers. As a result of the tests which included heating and cooling operations, all the specimens were found to possess the mechanical properties needed for cold-wrought heat exchanger tubes. The presence of Ti affected primarily the nature structural transformations which occur during slow cooling from a temperature above the critical point of the alloy. The experimental steels were twice as resistant to attack by sulfur-containing media than the base steel; they exhibited also a tendency toward second-order embrittlement upon quenching. (TTT)

3504 α-MANGANESE PHASES CONTAINING TECHNETIUM-99. D. J. Lam, J. B. Darby, Jr., J. W. Downey, and L. J. Norton (Argonne National Lab., Ill.). Nature, 192: 744(Nov. 25, 1961).

α-manganese phases were found in the binary systems Sc - Tc, Ti - Tc, Hf - Tc, and Ta - Tc, and their lattice parameters were determined. The lattice dimensions of an annealed needle of high-purity Tc metal were determined to be $a_0 = 2.743 \pm 0.001$ A, $c_0 = 4.400 \pm 0.001$ A, and $c/a = 1.604$, which agrees well with Mooney. (D.L.C.)

3505 ON THE TRIANGULATION OF THE TITANIUM–CARBON–MOLYBDENUM SYSTEM. V. N. Eremenko and T. Ya. Velikanova. Poroshkovaya Met., No. 3, 20-4(May-June 1961). (In Russian)

An investigation was carried out on the triangulation of the titanium–carbon–molybdenum system, employing the method of intersecting sections in conjunction with metallographic and roentgenographic methods. The trend of various reactions in the Ti–C–Mo system was evaluated on the basis of the data in the literature. The results obtained furnished a basis for the conclusion that the TiC–Mo section of the ternary titanium–carbon–molybdenum system is quasibinary. The conclusion was drawn that it is necessary to revise the boundary of the phase fields in the isothermal diagram of the titanium–carbon–molybdenum system proposed by Albert and Norton. (auth)

3506 THERMOPHYSICAL PROPERTIES OF ALLOYS IN SYSTEMS OF BORON–NITROGEN, BORON–CARBON, SILICON–NITROGEN AND BORON–SILICON–CARBON. G. V. Samsonov (Inst. of Metalloceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Poroshkovaya Met., No. 3, 53-62(May-June 1961). (In Russian)

An investigation was made of the properties of a number of high-temperature semi-conducting alloys manufactured by powder metal methods. It is shown that the compound BN in the boron–nitrogen system possesses an extensive region of homogeneity; the rearrangement of the boron lattice during nitrogenization leads to the formation of alloys in the nitride homogeneity region with predominance of electronic conductivity. With an increase in the nitrogen content in the nitride the electrical resistance of the latter sharply rose to 35 to 38% of nitrogen, after which the rise in resistance was decelerated, which was accounted for by the participation in the conductivity of electrons effecting the bonds between the plane layers of atoms in the nitride structure. It was established that Si_3N_4 is a semiconductor with a resistance at room temperature of 10^{13} to 10^{14} ohm cm and a width of the forbidden zone 3.9 to 4.0 ev. The nature of the effect of additions of carbon and titanium on silicon nitride conductivity is shown. The existence of two carbides, B_4C and $B_{12}C$, in the boron–carbon system is shown. Both of them are semiconductors, the width of the forbidden zone for B_4C being established as 1.64 ev. The existence of a number of ternary semiconductor compounds, distinguished by high thermal emf values, as high as 500 to 600 μv/degree, was established for the boron–silicon–carbon system. (auth)

3507 ON THE EFFECT OF THE METHOD OF HEATING ON THE DURABLE STRENGTH OF CERTAIN METAL POWDER MATERIALS. A. F. Tereshchenko (Inst. of Metalloceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Poroshkovaya Met., No. 3, 75-8(May-June 1961). (In Russian)

The data of an investigation of the durable strength of two types of metal powder materials, Cr_3C_2 and SiC were collected. It is shown that the method of heating has no substantial effect on the strength of these compositions. (auth)

3508 THE METHOD OF NEUTRON DIFFRACTION IN THE STUDY OF MAGNETIC STRUCTURES. A. F. Andresen (Institutt for Atomenergi, Kjeller, Norway). Svensk Kem. Tidskr., 73: 440-6(1961). (In Norwegian)

A survey is given of the possibilities and limitations of the neutron diffraction method in determining magnetic structures. Applications of the method are illustrated by recent work at Institutt for Atomenergi, Kjeller. (auth)

3509 PROGRESS IN CERAMIC SCIENCE. VOLUME 1. J. E. Burke, ed. New York, Pergamon Press, 1961. 238p. $10.00.

Authoritative critical reviews of various aspects of ceramic science and ceramic engineering are provided in order to analyze the critical problems and thus aid in the development of the science by showing where new knowledge is needed. The topics discussed are: glass strength, vaporization of oxides, cement hydration, deformation and fracture of ionic crystals, and chemical approach to problems of the glassy state. (N.W.R.)

3510 ANTIMONY, BISMUTH, GALLIUM, INDIUM, SELENIUM, AND TELLURIUM. OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). Sept. 1960. 16p. (SB-438). $0.10(OTS).

A bibliography is presented on Sb, Bi, Ga, In, Se, and Te. The 259 references given were added to the Office of Technical Services' collection during the period 1950 to October 1960. (M.C.G.)

3511 GLASS. OTS Selective Bibliography. Supplement to CTR-370. (Office of Technical Services, Washington, D. C.). Aug. 1961. 21p. $0.10(OTS). (SB-478)

A bibliography is presented listing the 301 reports added to the Office of Technical Services collection on glass during the period April 1959 to August 1961. (M.C.G.)

3512 FIBER GLASS AND GLASS LAMINATES. OTS Selective Bibliography. Supplement to CTR-292. (Office of Technical Services, Washington, D. C.). Sept. 1961. 11p. $0.10(OTS). (SB-479)

A bibliography is presented listing 114 reports on fiber glass and glass laminates added to the Office of Technical Services Collection during the period from November 1959 to October 1961. (M.C.G.)

3513 REDKIE METALLY I SPLAVY. TRUDY PERVOGO VSESOYUZNOGO SOVESHCHANIYA PO SPLAVAM REDKIKH METALLOV, 18-20 NOYABRYA 1957. (Rare Metals and Alloys. Proceedings of the First All-Union Conference on Rare Metal Alloys, November 18-20, 1957). E. M. Savitskii, ed. Moscow, Metallurgizdat, 1960. 404p.

Thirty-five papers are included on the structure, properties, metallurgy, and applications of rare metals and their alloys. Information is reported on Ti–Cu base alloys with rare metal admixtures; Re, V, Rb, Zr, and their alloys; the effects of rare metals on the properties of magnesium alloys and steel; and the preparation of alloys with special physical properties. (R.V.J.)

3514 IMPROVEMENTS IN OR RELATING TO METALLO-CERAMIC COMPOSITIONS. Simon Lyon Ruskin. British Patent 881,184. Nov. 1, 1961.

A process is outlined for preparing cermet compositions of great hardness, abrasion resistance, uniform texture, and other unique properties. The process comprises irradiating one or more metal oxides or a mixture of metal and metalloid oxides with 100 to 400 Mr/g. The irradiation induces partial reduction to the extent of 0.2 up to 5%, and the reduction may be promoted by carrying out the irradiation in water or in an oxidizable medium such as silicon dioxide and glycerol. Several examples of the process are given. (D.L.C.)

3515 BITUMINOUS COMPOSITION. Arthur Evans and Walter Jacob Rosenfelder (to Borax Consolidated Ltd. and Berry Wiggins & Co. Ltd.). British Patent 881,223. Nov. 1, 1961.

A bituminous composition suitable for use as neutron shielding material in reactors comprises a bitumen having a hydrogen content of at least 10 wt % and blended with a bitumen-soluble boron compound to give a final boron content of 1 to 5%. Suitable boron compounds include various organic esters of boric acid, such as alkylene glycol diborates and alkyl borates. Boron trifluoride, which reacts with bitumen to form a complex, may also be used. A gamma shield should be provided for this neutron shielding composition. (D.L.C.)

3516 AUSTENITIC CHROMIUM–NICKEL STAINLESS STEEL. (to Copperweld Steel Co.). British Patent 882,679. Nov. 15, 1961.

An austenitic stainless steel containing B and readily workable comprises 12 to 30% Cr, 6 to 20% Ni, 0.10 to 2.0% B, not more than 0.09% C, and balance Fe. The B is in the form of a complex B-containing constituent dispersed uniformly in an austenitic matrix. The mechanical properties and corrosion resistance of the B-containing stainless steel are found to be poor in comparison with those of a similar stainless steel free from B, but it is still a useful material for construction of reactor shields and control elements, particularly when it is clad with a B-free austenitic Cr–Ni stainless steel. (D.L.C.)

Radiation Effects

Refer also to abstract 3324

3517 (60GL80) HOW RADIATION FROM A NUCLEAR EXPLOSION MAY AFFECT ELECTRONIC EQUIPMENT. W. R. Langdon (General Electric Co. General Engineering Lab., Schenectady, N. Y.). Apr. 21, 1960. 30p.

Results of tests indicated that high radiation dose rates resulting from nuclear explosions are capable of causing malfunction of electronic equipment at very great distances from the explosion. High speed aircraft would be particularly vulnerable to equipment failure. Radiation effects on materials and components of electronic equipment were examined under various conditions. It was concluded that the use of inorganic materials and low impedance circuits would eliminate the problem to a large extent. It is recommended that electronic circuits be examined carefully in the light of their possible sensitivity to radiation pulses. (C.H.)

3518 (AFCRL-351) EFFECTS OF RADIATION ON FERROELECTRIC AND FERRIMAGNETIC MATERIALS. PART I. FERROELECTRIC MATERIALS. Final Report. L. G. Wright, C. A. Rosen, and S. I. Taimuty (Stanford Research Inst., Menlo Park, Calif.). May 1, 1961. Contract AF19(604)-4141. 83p. (AD-257823)

The effects of reactor radiation and Co^{60} gamma radiation on the dielectric properties of four ceramic ferroelectric materials were studied. The materials ($BaTiO_3$, 96% $BaTiO_3$–4% ($PbTiO_3$, 95% $BaTiO_3$–5% $CaTiO_3$, and PZT) were given reactor fast-neutron exposures in the range 10^{15} to 10^{18} n/cm^2 or a gamma radiation exposure of 3.7×10^8 rads. Complex permittivity and large-signal hysteresis properties were measured before and after irradiation, after room temperature aging, and after 500°C heat treatment. The effects on the dielectric constant (the real part, ϵ, of the complex permittivity) were small after fast-neutron exposures below 10^{18} n/cm^2. After 10^{18} n/cm^2, average decreases in the value of ϵ of 30% at 12 days after irradiation and 55% at 255 days after irradiation were observed. After heat treatment ϵ increased but did not reach its pre-irradiation value. The quality factor, Q, decreased after all irradiation exposures; it increased following aging and heat treatment, approaching its original value. The total hysteresis loss at constant maximum electric displacement, D, increased, and the changes in the hysteresis loops were large only in samples exposed to 10^{18} n/cm^2. Following irradiation loop distortions were observed, the total hysteresis loss measured by the loop area increased, and the electric displacement, D, for constant electric field, E, decreased. The changes in ϵ and Q in the gamma irradiated samples were similar to but smaller than those in the neutron irradiated samples. The hysteresis loops were less affected, and the loop changes were opposite those produced by neutrons. Hysteresis loss at constant maximum electric displacement D, decreased, and electric displacement at constant field increased. (auth)

3519 (ASD-TR-61-511(Vol.II)) NGL PLATFORM NUCLEAR RADIATION PROGRAM. VOLUME II. MATERIAL AND NGL COMPONENTS APPENDICES SECTION. Alvin B. Kaufman and Leonard B. Gardner (Litton Systems, Inc., Woodland Hills, Calif.). Oct. 1961. Contract AF33 (600)-41452. 245p.

The modification and testing of the gyro, accelerometer, d-c amplifier, and other components were carried out to produce a system capable of operating in a combined steady state or pulse nuclear environment. Four different nuclear facilities were utilized for the radiation tests. The test program indicated that within certain limitations, the components could be modified or redesigned to achieve the specified goal. (auth)

3520 (BMI-1552) IN-PILE FISSION-GAS-RELEASE BEHAVIOR OF ALUMINA-COATED UO_2 PARTICLES IRRADIATED TO HIGH BURNUP. Gilbert E. Raines and William H. Goldthwaite (Battelle Memorial Inst., Columbus, Ohio). Nov. 6, 1961. Contract W-7405-eng-92. 39p.

Several types of coated-particle fuel materials and coated-graphite fuel elements were irradiated at temperatures up to about 1350°F to a total uranium burnup of about 6 at.%. The fission-gas-release behavior of one of these materials, 100 to 140-μ-diameter UO_2 particles coated with 40 μ of vapor-deposited Al_2O_3, was studied in detail. The fission gas released by this material was brought by a flowing stream of helium from the specimen to a point where it was sampled intermittently so that the amount released could be determined. Stainless steel mesh traps were placed close to the capsule from time to time to trap the solid decay products of the short-lived fission gases. The fission-gas retention of this material was extremely good at low burnup when the particle coatings were intact. Deterioration was first noted at 1 at.% burnup, and became relatively severe at between 3 and 5 at.% burnup. Cracking of particle coatings was the cause of deterioration. Fission-gas release initially was approximately 10^{-7} and at about 6 at.% burnup was 10^{-2} for the long-lived fission gases and below 10^{-4} for most of the shorter lived ones. (auth)

3521 (IBM-61-521-10) STUDY OF EFFECT OF HIGH-INTENSITY PULSED NUCLEAR RADIATION ON ELECTRONIC PARTS AND MATERIALS (SCORRE). Report No. 5. Quarterly Progress Report No. 5, July 1, 1961–September 30, 1961. (International Business Machines Corp. FSD Space Guidance Center, Owego, N. Y.). Contract DA36-039 SC85395. 16p.

The radiation tests to be conducted at the Sandia Pulsed Reactor Facility are described. The electrical behavior of glass-dielectric capacitors will be observed during the bursts. (auth)

3522 (NP-11121) MONTHLY ACCESSION LIST NO. 52, [ON RADIATION EFFECTS DATA], OCTOBER 1–OCTOBER 31, 1961. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Nov. 15, 1961. Contract AF33(616)-7375. 24p.

An abstract listing is given of literature acquisitions on electronics, space, polymers, organic and inorganic chemistry, metals and ceramics, dosimetry, and information of general interest. (J.R.D.)

3523 (VDIT-16.1 a) RADIATION EFFECTS ON SOLID, URANIUM BASED NUCLEAR FUEL MATERIALS. Appendix to Part VDIT–16.1. A Bibliography. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Nov. 1961. 16p.

Forty-two abstracts of publications on radiation effects on solid, uranium based nuclear fuel materials are presented. (M.C.G.)

3524 (CEA-tr-R-1351) EXAMEN DE L'ETAT CHIMIQUE DU RADIOPHOSPHORE DANS LES CRISTAUX DE KCl IRRADIES PAR DES PROTONS DE HAUTE ENERGIE. (Examination of Chemical State of Radiophosphorus in KCl Crystals Irradiated with Protons at High Energies). A. N. Murin, S. N. Banashevich, and R. V. Bogdanov. Translated into French from "Conference on Chemical Reactions in Nuclear Transmutations" held at Prague, 1960. 22p.

The chemical state of P^{32} formed in KCl crystals irradiated with high-energy protons was studied. After the irradiation the crystals were subjected to thermal treatments and the P^{32} was separated chemically. The results showed that a great effect on the ratio between the valence states of the phosphorus in the crystal is exercised by the history of the sample and by the thermal treatments of the irradiated crystal. Curves showing the oxidation kinetics of the P^{32} in the crystals were constructed for 200, 250, 300, and 400°C. The initial distribution of phosphate, phosphite, and hypophosphite in the irradiated crystal were determined and tabulated. A theoretical interpretation of the experimental results was presented. (J.S.R.)

3525 THE INFLUENCE OF γ-RADIATION ON THE CATALYTIC ACTIVITY OF PLATINIZED ALUMOSILICATE. Kh. M. Minachev, M. A. Markov, and Yu. S. Khodakov (Zelinskii Inst. of Organical Chemistry, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, No. 7, 1227-30(July 1961). (In Russian)

The effect of γ radiation on the catalytic activity of platinized aluminum silicate in cyclohexane hydrogenation was investigated. The rate of hydrogen peroxide dissociation increases with increased radiation dose. (R.V.J.)

3526 ELASTOMERS FOR USE IN RADIATION FIELDS: PART VI. RADIATION RESISTANCE OF THE NEOPRENES. Robert Harrington (General Electric Co., Richland, Wash.). Rubber Age (N. Y.), 86: 819-25(Feb. 1960).

Data are presented on the radiation resistance of six of the more commonly used neoprene polymers and how they are affected by some compounding ingredients. In general, tensile strength is the property most sensitive in reflecting the changes caused by different amounts and types of compounding ingredients. Fillers regulate the behavior of tensile strength. Flexibility is also a relative sensitive property for reflecting changes in neoprenes after irradiation. Oxygen apparently plays a minor role in radiation-induced damage to neoprenes. An analysis of the data shows that frequently certain effects caused by materials are masked. Over-all changes are roughly a sum of individual net effects. (N.W.R.)

PHYSICS

General and Miscellaneous

3527 (AFCRL-75) FREQUENCY MIXING WITH SUPERCONDUCTING ELEMENTS. Final Report. Sidney Shapiro (Little (Arthur D.) Inc., Cambridge, Mass.). Mar. 1961. Contract AF19(604)-5889. 46p. (AD-258087)

The problem of microwave frequency mixing using superconducting elements is examined. One investigation involves the non-linear effects associated with the superconducting-normal phase transition. Another investigation treats the electrodynamics of superconductors with particular attention to a possible non-linear effects associated with a body maintained within the superconducting state. The details of an experimental program designed to investigate the latter effects are given. (auth)

3528 (AFOSR-860) ENERGY EXCHANGE IN THE HIGH-INTENSITY ARC PLASMA. TECHNICAL NOTE NO. 1. EFFECT OF FLUID TRANSPIRATION THROUGH THE ANODIC ARC BOUNDARY. C. Sheer, J. A. Cooney, D. L. Rothacker, and F. R. Sileo (Vitro Labs., West Orange, N. J.). June 16, 1961. Contract AF49(648)-477. 215p. (VL-2143-10-0)

A basic discussion of arc phenomena is presented for the purposes of orientation and definition. Emphasis is placed on the distinction between low-intensity and high-intensity modes of arc operation. Following the preliminary discussion, the fundamental premises for the concept of a "fluid transpiration" arc are laid down. This concept relates to an arc discharge subject to the forced convection of a fluid medium, but differentiated from other systems of this type by the fact that the fluid is injected into the arc conduction zone via the anodic terminus through a porous anode structure. The postulated effectiveness criteria for this technique of arc heating require that the average pore size be less than the anode fall space thickness, that the transpiration surface be integrally congruent with the anodic discharge boundary, and that the injected gas particle flux density have the same order of magnitude as the opposing drift electron flux density within the anode sheath region. A two-phase experimental program is described, the first being concerned with the validation of the basic concept and the second with a study of intrinsic characteristics. The first group of experiments established the feasibility of fluid transpiration through the anodic arc boundary as a practical method of arc heating. Transition to a new mode of arc operation at a specific rate of fluid flow was demonstrated. The new mode exhibited general features similar to a Beck type high-intensity arc, but in some respects it is shown to be different. The second group of experiments detailed a number of unique properties for the technique of fluid transpiration through the anode. Some evidence was obtained for an abnormally high degree of ionization in the plasma jet. Erosion tests on both porous graphite and tungsten demonstrated that steady state anode consumption as low as 10^{-6} gms/sec are achievable in an argon medium. The major cause of anode wear was found to be spalling of surface fragments due to arc ignition stresses. A very pure plasma jet, essentially free of electrode vapor, was generated for a wide range of gas flow rates. Anode erosion using helium gas was found to be higher than that for argon, other things being equal. This is tentatively explained as an effect of relative atom-electron collision cross-sections in the anode sheath. Normalized specific enthalpies between 1.0 and 5.0 k-cal/gm mole-kw at transfer efficiencies between 70 and 88.5% are reported. Probe experiments revealed an apparent smoothing effect for gas transpiration through the anode on the flow regime in the effluent plasma. In addition an appreciable fraction ($^1/_2$ to $^3/_4$) of the anode fall voltage was found to be detached from the anode surface by the gas flow, effectively dividing the fall space into two separate zones. These two zones are separated by an "anode dark space," characterized by the absence of luminosity and essentially zero voltage gradient. Finally, a new geometry, involving a truncated conical shell for the porous anode and a conical gas conduction zone, is shown to generate a region of exceptionally high energy density and provide a higher power input capability. (auth)

3529 (ANL-6432) PHYSICS DIVISION SUMMARY REPORT, SEPTEMBER–OCTOBER 1961. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 30p.

The use and operation of the 4.5-Mev Van de Graaff generator in the period is described. The peak height and the spin of the 27-kev resonance of fluorine was studied further by the method of analysis employed by Lane, Morehouse, and Phillips. A second method developed by Monahan and Hibdon was also applied to this resonance. Both methods indicate a value of J = 2. The use of Philips 56AVP and 56UVP photomultipliers as detectors in measurements of the decay times of fast scintillations is discussed. Work on the deformation energy of a charged liquid drop and on the π-π resonance contribution to low-energy π-N scattering is summarized. (D.L.C.)

3530 (ANL-6463) EFFECTS OF SPIN-ORBIT COUPLING IN Si AND Ge (thesis). L. Liu (Argonne National Lab., Ill.). Nov. 1961. Contract W-31-109-eng-38. 72p.

Thesis submitted to Univ. of Chicago.

A treatment of spin-orbit effects in some semiconductors is given using the effective mass method and orthogonalized-plane-wave type wave functions. In this formalism, the spin-orbit splitting of valence states in the crystal is expressed directly in terms of either experimental or calculated values of the spin-orbit splitting of the atomic core states. The calculation yields values in good agreement with experiments for the splitting at Γ_{25}, for Si and at both Γ_{25}, and L_3, for Ge. A demonstration is given of the enhancement of the spin-orbit splitting of valence states in the crystal over the corresponding atomic value. The shift in the g-tensor due to spin-orbit interactions is studied in Si and Ge. Because of crystal selection rules, the usual two band approximation to the effective mass sum rule is inadequate for Si and, in particular, the core state must be considered. When all important states are included, the calculations yield values in good agreement with experiment. In the case of Ge, it is found that core states do not contribute appreciably to the g-tensor. However, the calculated value for the shift in the transverse component of the g-tensor has an opposite sign to the measured one. A certain matrix element of the deformation potential for Si is also evaluated based on the measured shift in the g-value due to strain. The result is compared with other deformation potentials in Si. (auth)

3531 (CAL-RM-1396-A-1) DEVELOPMENT OF A SHOCK-TUBE DRIVEN MOLECULAR BEAM. George Skinner (Cornell Aeronautical Lab., Inc., Buffalo). Oct. 1961. Contract AF49(638)-793. 69p. (AFOSR-166)

The preliminary development of a high intensity molecular beam, in which a small tailored-interface hypersonic shock-tunnel is used as the gas source, is reported. The aim of the development program is to extend molecular beam techniques into the 1-10 ev per particle range by utilizing the capability of the shock tube to generate high temperatures. A 0.7 ev N beam was produced in the pilot apparatus. The intensity of 2.5×10^{18} molecules cm^{-2} sec^{-1} and the spreading angle of 6° agree with a theoretical analysis which takes into account attenuation caused by scattered molecules which have been thermally accommodated at the walls of the apparatus. A modified Kantrowitz-Grey system is used to obtain the high-energy beam. (auth)

3532 (NP-10709) ANALYS MEDELST GAMMA-SPEKTROMETRI. (Analysis by Gamma-Spectrometry). Dag Brune (Aktiebolaget Atomenergi, Stockholm). 1961. 10p. (AES-1)

The interpretation of spectrograms and quantitative analysis by means of spectrography are reviewed. Methods for optimization of a given activity and formulas for the direct evaluation of the gamma spectrometric analytical sensitivity for various materials are given. (tr-auth)

3533 (NP-10959) ADVANCED ION BEAM DIAGNOSTIC TECHNIQUES. J. M. Sellen, Jr., S. G. Forbes, R. F. Kemp, H. Shelton, and J. C. Slattery (Space Technology Labs., Canoga Park, Calif.). [1961]. 51p.

Paper No. 2067-61 presented at American Rocket Society Space Flight Report to the Nation, New York Coliseum, October 9-15, 1961.

A series of experiments in the diagnosis of a neutralized high aspect ratio cesium ion beam is described. Experimental apparatus, medium chamber neutralization experiments, electron time-of-flight potential probe, Langmuir and emissive probes, numerical analysis of potentials in an ion-electron assembly, large chamber neutralization experiments, and small chamber neutralization experiments are discussed. The measurements in the ion beam demonstrated the point-by-point neutrality of the ion-electron plasma. (M.C.G.)

3534 (NP-11091) SURFACE IMPEDANCE OF THIN SUPERCONDUCTING FILMS. Technical Report No. 17. Peter V. Mason (California Inst. of Tech., Pasadena. Electron Tube and Microwave Lab.). Oct. 1961. Contract Nonr-220(13). 144p.

The propagation of electromagnetic waves is investigated experimentally and theoretically in a planar structure consisting of a thick superconductor (Ta), a dielectric layer on the order of thickness of a penetration depth (Ta oxide), and a superconducting film on the order of thickness of a penetration depth (In). It is shown that this sandwich propagates electromagnetic waves at a velocity smaller than the phase velocity in the dielectric layer. The propagation velocity is found to depend on the thickness parameters, the vector potential of In, and the supercurrent in In. The penetration depths of Ta and In at 0°K are calculated from the dependence of the phase velocity on the system's dimensions and the temperature. The effects of the frequency and temperature on the surface resistance of the two superconductors are found. (T.F.H.)

3535 (NP-11112) RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM. Seventh Quarterly Progress Report, June 16, 1961 through September 15, 1961. R. Novick (Columbia Univ., New York. Columbia Radiation Lab.). Sept. 15, 1961. Contract DA-36-039 SC-78330. 62p. (CU-9-61 SC-78330 Phys.).

The 10-cm maser-radiometer is being used at the Naval Research Laboratory, initially for measurements on the planet Saturn. Experiments are described using an M-band radiotelescope at Columbia in an attempt to measure sextuply ionized nitrogen in the sun's corona. Developments in the production of a microwave cavity charged-particle-detector are discussed. A detailed discussion of several major maser projects is given, including recent work with optical masers. A number of projects dealing with microwave and atomic beam spectroscopy are described. Progress in studies of various atomic properties by means of high sensitivity optical double resonance methods is reported, including work on several isotopes of cadmium. An experiment to determine the lifetime of metastable helium ions is described in detail. Preliminary data are reported for an experiment to determine the interaction between a molecule and a conducting surface. (auth)

3536 (RM-2776-AEC) THE MÖSSBAUER EFFECT. S. A. Moszkowski (RAND Corp., Santa Monica, Calif.). May 10, 1961. Contract AT(29-1)-1477. 45p.

Some of the highlights of the Mössbauer effect and its applications, especially the verification of the gravitational red shift are discussed. The conditions for the occurrence of recoil-free resonance absorption of gamma rays are also reviewed. (auth)

3537 (UCRL-6525-T(Rev.)) REARRANGEMENT COLLISIONS BETWEEN MUTUALLY ORTHOGONAL STATES. B. A. Lippmann (California. Univ., Livermore. Lawrence Radiation Lab.). July 1961. Contract W-7405-eng-48. 6p.

An expression recently given for the transition amplitude in a general rearrangement collision, containing transitions only between mutually orthogonal states, is shown not to be valid generally, but only when the initial and final states actually are mutually orthogonal. (auth)

3538 (AEC-tr-3973(Pt.II and Add.)) ADVANCES IN PHYSICAL SCIENCES. PART II. Translation of Uspekhi Fiz. Nauk, 63: Nos. 3-4, 461-864(Nov.-Dec. 1957). ADDENDA. Ibid. 61: Nos. 1-4, 27-43; 137-59; 423-50; 562-612(1957). Ibid. 62: No. 2, 159-86; 191-6(1957). 638p. (PST-Cat.-112)

3539 (AEC-tr-3973(Pt.II and Add.)(p.721-81)) ELECTRON PARAMAGNETIC RESONANCE. S. A. Altshuler and B. M. Kozyrev. Translated from Uspekhi Fiz. Nauk, 63: 533-73(1957).

A review of information on past developments and present research efforts is presented. Included are sections devoted to relations of paramagnetic resonance to magnetism and spectroscopy, study methods for paramagnetic resonance, spectra of ionic crystals such as those in the Fe group, rare earths, and the actinides. Associated information is included concerning hyperfine resonance spectra, covalent binding in 3d, 4d, and 5d-transition groups, and results of spectral investigation of ionic crystals. Other data and theory concerning the shape of the paramagnetic resonance lives in ionic crystals, and resonance in liquid electrolytes and free radicals are also included. (J.R.D.)

3540 (AEC-tr-3973(Pt.II and Add.)(p.834-74)) LARGE AMPLITUDE SHOCK WAVES IN GASES. Ya. B. Zel'dovich and Yu. P. Raizer. Translated from Uspekhi Fiz. Nauk, 63: 613-41(1957).

Various physical processes which occur in the front of a shock wave are considered along with their effects on the internal structure of the front. Special attention is paid to the processes of light emission and absorption, and radiation heat exchange in the front. (J.R.D.)

3541 (FTD-TT-61-94) AN INVESTIGATION OF HIGH-FREQUENCY DISCHARGE IN THE BAND FROM

1.5 TO 15 MC III. A. A. Kuzovnikov (Kuzovanikov) and N. A. Kaptsov. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 6, 64-70(1960). 13p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 13500.

3542 (JPRS-8937) TRANSLATIONS OF (ACTA PHYSICA SINICA), Wu Li Hsüeh Pao, 15: No. 2, 55-75; 77-87; 89-111(Feb. 1959). Ibid. 15: No. 3, 113-29; 131-7; 139-65(Mar. 1959). 180p.

A translation is presented of 9 articles from Wu-li Hsueh-pao (Acta Physica Sinica). One separate abstract was prepared. Five papers were previously abstracted for NSA. Papers not abstracted covered the following topics: general method for solving magnetic circuit and non-linear electric circuit of direct current, some problems of the physics of frictional wear, and growth of NaCl single crystals from sublimed vapor. (M.C.G.)

3543 GENERALIZED FREE FIELDS AND MODELS OF LOCAL FIELD THEORY. O. W. Greenberg (Massachusetts Inst. of Tech., Cambridge). Ann. Phys. (N. Y.), 16: 158-76(Nov. 1961).

Generalized free fields are a generalization of the free field in which the commutator is a c-number but does not satisfy a homogeneous Klein-Gordon equation. Some properties of generalized free fields are examined including the appropriate generators of the inhomogeneous Lorentz group, the number operator, spectrum, locality, and asymptotic fields. These generalized free fields are used to construct a family of local field theory models which is not unitarily equivalent to any (generalized) free field. (auth)

3544 SYMMETRY THEORY OF THE AHARONOV-BOHM EFFECT: QUANTUM MECHANICS IN A MULTIPLY CONNECTED REGION. Lindsay J. Tassie and Murray Peshkin (Argonne National Lab., Ill.). Ann. Phys. (N. Y.), 16: 177-84(Nov. 1961).

The conventional Schrödinger treatment of the Aharonov-Bohm effect of inaccessible magnetic fields postulates the use of single-valued wave functions, even in a multiply connected region. The principles of symmetry theory are shown to justify this postulate in a cylindrically symmetric system, and to lead directly to the Aharonov-Bohm effect. The necessity for the canonical angular momentum to be an integer or half-integer is the crux of the argument. (auth)

3545 ON THE THERMODYNAMIC PHASE DIAGRAMS OF HELIUM THREE. Louis Goldstein (Los Alamos Scientific Lab., N. Mex.). Ann. Phys. (N. Y.), 16: 205-34(Nov. 1961).

An analysis of thermodynamic consequences resulting from the observed anomaly at the temperature T_a of the melting pressure line P(T) of He^3 through the formation of a minimum at this temperature is given. The anomalous character of the volume line $V_l(T)$ of the liquid, in equilibrium with the solid, is proved on the basis of data available on the high temperature side of T_a and at T_a. This volume anomaly consists in a maximum of $V_l(T)$ at T_a. The similar anomaly of the solid volume line $V_s(T)$ at T_a results from the temperature double-valuedness of the isobaric and isochoric states of the liquid and solid along the phase equilibrium lines. The saddle point type character of the states $[P(T_a), V_l(T_a)]$ and $[P(T_a), V_s(T_a)]$, combined with the existence of the locus of vanishing expansion coefficients of the liquid, led to recognizing the oscillatory character of the isobar of pressure $P(T_a)$ and isochore of volume $V_l(T_a)$ of the liquid. The oscillations result from the vanishing of the second partial temperature derivatives of these isobar and isochore of anomaly at three different temperatures, the temperature T_a being one of these. These impose the occurrence of probably observable anomalies in constant pressure and constant volume heat capacities of higher pressure, $p \sim P(T_a)$, and smaller volume $V \sim V(T_a)$. The anomalous isobaric lines yield a fairly complete description of the associated expansion coefficients of the liquid. The vanishing expansion coefficient of both the liquid and the solid at the states of anomaly will be shown to result directly from the saddle point type character of these states of the two phases. Features of the isothermal compressibility of the liquid will be derived, together with its evaluation at isolated states of these two phases in equilibrium from local behavior of the equilibrium lines P(T), $V_l(T)$, and $V_s(T)$. (auth)

3546 EXPERIMENTAL STUDY OF THE LONGITUDINAL ANGULAR DISTRIBUTIONS OF PHOTO-ELECTRONS FROM THE INNER ELECTRON SHELLS OF URANIUM. Ziemowid Sujkowski (Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 20: 269-88(1961). (In English)

Longitudinal angular distributions of photo-electrons from uranium targets were studied using the beta-spectrometric technique. Distribution functions are obtained for the following gamma ray energies and electron shells: 103 kev ($L_I + L_{II}$, L_{III} and M shells), 279 kev (K shell) and 2750 kev (K shell). The true K279 photo-electron distribution is obtained by the experimental determination of the scattering and geometrical (finite size) distortion effects. The distribution is compared to theoretical differential cross-sections obtained from Sauter's formula and from numerical calculations based on relativistic formulae valid for any Z (Nagel). Very good agreement with the latter is obtained. The ratios of the photo-electric absorption in different shells at hν = 103 kev are determined to be: $\tau_{L_I + L_{II}}/\tau_{L_{III}} = 3.03 \pm 0.15$; $\tau_L/\tau_M = 3.70 \pm 0.20$. Complementary measurements of these ratios at hν = 81.0 kev and hν = 279 kev are reported. The value $\tau_{L_{II}}/\tau_{L_{III}} = 0.92 \pm 0.15$ for hν = 81 kev is given. Other experimental data available on these ratios are discussed. It is shown that the experimental results are in disagreement with the existing theoretical predictions. (auth)

3547 LUMINESCENCE IN KI:Tl. J. E. Alderson and S. E. Williams (University of Western Australia, Nedlands). Australian J. Phys., 14: 368-80(Sept. 1961).

Freshly cleaved single crystals of KI:Tl containing various concentrations of Tl are irradiated in a vacuum monochromator in the 2800 to 1100 Å region at −140 to 45°C. The relative luminescence efficiencies in the Tl absorption bands and the host crystal fundamental absorption show that energy is transferred from host crystal to impurity center to produce luminescence at room temperatures. To the high energy side of a threshold, which appears to depend on activator concentration, the luminescence efficiency is superlinear above about 15°C for KI:Tl (0.0005%). Luminescence production shows a slow build-up which is analyzed in detail for irradiation at 1608 and 1216 Å. The build-up curve is found to have the form $L_t = L_s\{A(1 - e^{-yt}) + B(1 - e^{-zt})\}$, where L_s is the saturation luminescence, L_t the luminescence t seconds after illumination starts, and A, B, y, and z are parameters associated with two processes for luminescence production involving recombination and the attainment of equilibrium in the filling of traps. The efficiency of the first process is superlinear and of the second approximately linear. There is no observable phosphorescent decay. Thermal escape from traps followed by radiationless de-excitation is observed by investigating the changes of the instantaneous component of luminescence production with varying intervals of darkness. An explanation is proposed in terms of the migration of holes from shallower to deeper traps

near luminescence centers followed by recombination with free electrons. (auth)

3548 TRANSMISSION AND REFLECTION OF ELECTROMAGNETIC WAVES AT A PLASMA BOUNDARY FOR ARBITRARY ANGLES OF INCIDENCE. K. A. Graf and M. P. Bachynski (RCA Victor Co., Ltd., Montreal). Can. J Phys., 39: 1544-62(Nov. 1961).

The interaction of a plane electromagnetic wave with a flat free-space plasma interface was considered for arbitrary angles of incidence. It is shown that the plasma can support independent horizontally and vertically polarized waves. Expressions and graphical representations are given showing the amount of energy entering the plasma as a function of angle of incidence and plasma parameters. The vertically polarized case shows a maximum in the energy entering the plasma at the "Brewster angle." For a lossy plasma, at this maximum, there will be reflection. Loci of constant Brewster angle appear as concentric curves centered on the origin of the complex dielectric coefficient plane. The elliptical polarization of plane wave reflected from the interface, when a wave with equal horizontally and vertically polarized components is incident on the interface, suggests the similarity of lossless plasmas to ordinary dielectrics and of lossy plasmas to metals. (auth)

3549 GENERAL FORMULA FOR THE SECOND VIRIAL COEFFICIENT. J. Van Kranendonk (Univ. of Toronto). Can. J. Phys., 39: 1563-72(Nov. 1961).

A simple derivation is given of the quantum mechanical expression for the second virial coefficient in terms of the scattering phase shifts. The derivation does not require the introduction of a quantization volume and is based on the identity $R(z)-R_0(z) = R_0(z)H_1R(z)$, where $R_0(z)$ and $R(z)$ are the resolvent operators corresponding to the unperturbed and total Hamiltonians H_0 and $H_0 + H_1$, respectively. The derivation is valid in particular for a gas of excitons in a crystal for which the shape of the waves describing the relative motion of two excitons is not spherical, and, in general, varies with varying energy. The validity of the phase shift formula is demonstrated explicitly for this case by considering a quantization volume with a boundary the shape of which varies with the energy in such a way that for each energy the boundary is a surface of constant phase. The density of states prescribed by the phase shift formula is shown to result if the enclosed volume is required to be the same for all energies. (auth)

3550 ON THE STATISTICAL PROPERTIES OF SOME TRANSPORT EQUATIONS. Adrian E. Scheidegger (Univ. of Illinois, [Urbana]). Can. J. Phys., 39: 1573-82 (Nov. 1961).

It is shown that, whenever a system is a linear combination of a larger number of fluctuating component systems and in the "large" system a certain quantity is a constant of the motion, under equilibrium conditions that quantity is canonically distributed in the component systems and, under non-equilibrium conditions (assuming linear regression of the fluctuations and microscopic reversibility), the quantity in question is subject to a diffusivity equation with a symmetric diffusivity tensor. Application of the above to porous media hydrodynamics immediately yields the equations for miscible displacement which were laboriously obtained earlier from a special statistical model. Similarly, the corresponding equations for suspended sediment transport in rivers and for the mixing of a pollutant in air are shown to be the result of an application of the above general statement. Finally, the theory is also applied to the inertial frequency range in the statistical theory of turbulence. (auth)

3551 VALUES OF THE TRANSPORT COEFFICIENTS IN A PLASMA FOR ANY DEGREE OF IONIZATION BASED ON A MAXWELLIAN DISTRIBUTION. I. P. Shkarofsky (RCA Victor Ltd., Montreal). Can. J. Phys., 39: 1619-1703(Nov. 1961).

Values are presented for the electronic conductivity for any degree of ionization, radiofrequency, and d-c magnetic field strength, and electron speed power law variations of the electron collision frequency with neutral particles. The other transport coefficients, such as electron current due to electron density gradients and temperature gradients, and energy flow due to an electric field and due to density gradients and temperature gradients, are tabulated. The analysis is based on substitution of the usual series expansion of Laguerre polynominals into the Fokker-Planck equation for Coulomb collisions and into the Boltzmann equation for electron collisions with neutral particles. For Coulomb effects, the expressions are the same as those derived by Landshoff. Collisions of electrons with neutral particles are included in addition to ions, and a-c electric fields are treated as well as d-c magnetic fields. In the limit of a completely ionized gas, the results also agree with those of Spitzer and Harm and of Kaufman. For a slightly ionized gas, the results are compared with Allis' treatment and with calculations using the Dingle integrals. It is found that the Laguerre convergence is inadequate for large angular frequencies when the power law is less than -2 and for small angular frequencies when the power law is greater than 1. The final results can be put in a form which yields two factors, multiplying, respectively, the average collision frequency and radian frequency, to give correct results from simple equations. These factors are usually of order one, and are functions of three parameters, proportional to angular frequency, ratio of electron-neutral to ion averaged collision frequency, and ion charge number. (auth)

3552 COLLISION MECHANICS IN CROSSED MAXWELLIAN MOLECULAR BEAMS. Sheldon Datz (Oak Ridge National Lab., Tenn.), Dudley R. Herschbach, and Ellison H. Taylor. J. Chem. Phys., 35: 1549-59(Nov. 1961).

A general treatment of the mechanics of collision between two Maxwellian molecular beams is described. Expressions are obtained for the distribution in collision energy, for the elastic and reactive collision rates, and for the angular distribution of the center of mass vectors for beams colliding at any angle. The treatment can accommodate any reaction cross section which can be expressed as a step function multiplied by a linear combination of powers of the relative energy. The recoil momentum, which affects the product distribution in the laboratory system, is discussed, and the treatment is applied to some experimental data on the reaction of K with HBr. (auth)

3553 TRANSPORT PROPERTIES OF POLAR GASES. L. Monchick (Johns Hopkins Univ., Silver Spring, Md.) and E. A. Mason. J. Chem. Phys., 35: 1676-97(Nov. 1961).

A model is proposed for the calculation of viscosity, diffusion, thermal diffusion, and the translational part of the heat conductivity of dilute polar gases. It is assumed that the molecular-collision trajectories are negligibly distorted by transfer of internal rotational energy, and that the relative orientation of two colliding dipoles remains fixed throughout the significant portion of the collision trajectory around the distance of closest approach. For this model, the Chapman-Enskog theory retains its usual form, but the collision integrals which appear must be averaged over all possible relative orientations occurring in collisions. Collision integrals were calculated for the Stockmayer (12-6-3) potential, $\varphi(r) = 4\epsilon_0[(\sigma_0/r)^{12} - (\sigma_0/r)^6 +$

$\delta(\sigma_0/r)^3]$, for kT/ϵ_0 from zero to 100 and for δ from −2.5 to +2.5, and averaged over all orientations (assumed equally probable). Sufficient collision integrals are tabulated that the convergence error of the Chapman-Enskog theoretical expressions is not a problem. Experimental viscosities and dipole moments of a number of polar gases were used to determine the potential parameters ϵ_0, σ_0, and δ, which were then used to calculate other properties for comparison with experiment. The over-all agreement between experiment and this model for polar gases is comparable to that of the Lennard-Jones (12−6) model for nonpolar gases. (auth)

3554 EFFECT OF PRESSURE ON THE OPTICAL PROPERTIES OF ORGANIC PHOSPHORS. D. W. Gregg and H. G. Drickamer (Univ. of Illinois, Urbana). J. Chem. Phys., 35: 1780-8(Nov. 1961).

The effect of pressure to 54 kbar was measured on absorption spectra, emission, spectra, and decay rates of four organic phosphors. For fluorescein and dichlorofluorescein the decay rate increases with increasing pressure. The emission spectrum consists of two peaks which approach each other at high pressure. Thus there appears to be an increased mixing of triplet and excited singlet states at high pressure. For acridine yellow and orange the absorption spectrum shows a dimer and monomer peak. The dimer peak decreases rapidly in intensity with increasing pressure. At high concentrations the component decay rates are largely independent of pressure. At lower concentrations the decay rate becomes slower at higher pressure. Evidently the emission can be associated with the dimer. (auth)

3555 NEGATIVE ION FORMATION IN OZONE. R. K. Curran (Westinghouse Research Labs., Pittsburgh). J. Chem. Phys., 35: 1849-51(Nov. 1961).

Negative ion formation in ozone was studied in a mass spectrometer. Negative ions of O, O_2, and O_3 were observed. The appearance potentials of O^- and O_2^- are O ev and 0.42 ± 0.03 ev, respectively. The data on O^- formation yield $D(O_2-O) \leq 1.02 \pm 0.15$ ev and the data on O_2^- formation lead to a limiting value for the electron affinity of O_2 of $EA(O_2) \geq 0.58$ ev. (auth)

3556 AN EXPLANATION OF THE SUPERIOR RADIATION RESISTANCE OF P-TYPE BASE Si SOLAR CELLS. Richard V. Babcock (Westinghouse Electric Corp., East Pittsburgh). J. Electrochem. Soc., 108: 1119-22(Dec. 1961).

Recent studies have shown p-type base Si solar cells to be considerably more resistant to 750 kev electron damage than similar n-type base cells. The effects of electron flux on solar efficiency, current voltage characteristics, and spectral response are predicted on the assumption that the only significant damage mechanism is decrease in the minority carrier lifetime in the base region. The calcula ions agree well with the reported electron damage effects, except that a rapid initial loss in efficiency of about 1% observed in n-type base cells is not reproduced. The usual method of measuring solar cell efficiency, comparing the response to a 2800°K tungsten light with that of a calibrated solar cell, was found to overestimate the effect of electron damage on the actual solar efficiency by as much as 200%. (auth)

3557 THE RESPONSE OF ORGANIC SCINTILLATORS TO FAST NEUTRONS. R. Batchelor, W. B. Gilboy, J. B. Parker, and J. H. Towle (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Instr. & Methods, 13: 70-82(Aug. 1961). (In English)

The pulse height distributions for organic liquid scintillation counters irradiated with fast neutrons are calculated using a Monte Carlo computer program. The results obtained at 1, 4, and 14 Mev neutron energies for a cylindrical scintillator 2 in. diameter × 2½ in. long are compared with experimental measurements and good agreement is obtained. In the experiments, the pulse shape discrimination and time of flight techniques are used independently to eliminate the effect of γ rays. The neutron detection efficiency is also measured in the energy range 0.4 to 3.5 Mev and the results compared qualitatively with those obtained by the Monte Carlo calculation. In addition the pulse height response of the liquid scintillator type NE213 for protons and electrons is obtained and this is similar to that of the plastic phosphor type NE102. (auth)

3558 A SPACE-TIME MODEL OF ISOSPACE. G. R. Allcock (Univ. of Liverpool). Nuclear Phys., 27: 204-33(1961). (In English)

The principle of combined inversion indicates a close relationship between isospace and ordinary space. The possible nature of this relationship is demonstrated with the help of a model, in which the isospin, baryon number, hypercharge, and charge conjugation operators appear as displacement operators, producing rotations within space-time itself. In the model the asymmetry of isospace appears as a consequence of relativistic covariance, and charge conjugation and parity appear as continuous transformations. (auth)

3559 FORMULATION OF STATISTICAL MECHANICS IN TERMS OF OCCUPATION NUMBERS. [PART] II. Roger Balian, Claude Bloch, and Cyrano de Dominicis (Centre d'Etudes Nucléaires, Saclay, France). Nuclear Phys., 27: 294-322(1961). (In French)

A physical interpretation of the generalized free energy F, introduced (Nuclear Physics 25: 529(1961)) in connection with the variational principle, is obtained by relating it to the statistical distribution of the occupation numbers. The values of the occupation numbers derived from the variational principle are then interpreted as the most probable values in a grand canonical ensemble of identical systems. As a particular consequence of the theory, it is shown that in the case of an infinite system without Bose condensation, the probability distribution of any occupation number has the same form as in the absence of interactions. The classical limit of the theory is then considered. First, the great similarity of our results with the classical expansions expressed in terms of the local density is exhibited by rederiving the well known classical expressions with previously given methods. Finally the classical limit of the Gibbs potential is shown to be identical, term by term, with the classical virial expansion. (auth)

3560 NONLINEAR EFFECTS IN TRANSPORT THEORY. James A. McLennan, Jr. (Université Libre, Brussels). Phys. Fluids, 4: 1446-7(Nov. 1961).

A method for the formal statistical description of transport processes beyond the linear approximation is discussed. External forces which maintain a deviation from equilibrium are introduced into the Liouville equation, and solution of this equation yields an ensemble characteristic of the non-equilibrium state. The transport relations are obtained with the aid of the resulting ensemble. For simplicity, the discussion is restricted to heat flow, but the generalization to the processes of viscosity and diffusion is straightforward. (auth)

3561 THERMAL DIFFUSION IN SOME MIXTURES OF INERT GASES. K. E. Grew and J. N. Mundy (Univ. of Exeter, Devon, Eng.). Phys. Fluids, 4: 1325-32(Nov. 1961).

Thermal diffusion is investigated experimentally in several binary mixtures of inert gases, especially at low reduced temperatures, and the results compare with theoretical values based on the Lennard-Jones and exponential-six molecular models. The thermal diffusion factor for krypton-argon mixtures is found to pass through a positive minimum value; this behavior, theoretically possible, has not previously been observed. Other mixtures examined are xenon-krypton and krypton-nitrogen; the mixtures of radon with neon, argon, and krypton; and the isotopic mixture $Ne^{22}-Ne^{20}$. (auth)

3562 INVESTIGATION OF SPINNING DETONATION AND DETONATION STABILITY. Russell E. Duff (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 4: 1427-33(Nov. 1961).

The stability of a detonation wave and the nature of a spinning detonation are investigated by observing the patterns inscribed by the wave in soot coatings on films located on the circumference of the detonation tube and on the end plate. The detonation instability reported by others persists to an initial pressure of over 2 atm and to wave velocities at least 75% greater than the equilibrium value. The wave front of a simple spinning detonation contains a complex Mach interaction with wave inclinations as high as 37° to the tube diameter. The acoustic theory of spinning detonation does describe high-order spin if it is assumed that two or more modes of vibration coexist. (auth)

3563 FLOW BETWEEN TWO CONCENTRIC ROTATING CYLINDERS WITH A RADIAL MAGNETIC FIELD. P. Ramamoorthy (Indian Inst. of Science, Bangalore, India). Phys. Fluids, 4: 1444-5(Nov. 1961).

The steady flow of an incompressible fluid between two concentric rotating cylinders under the influence of a radial magnetic field is examined. The analysis shows that the velocity in the magnetohydrodynamic case is lessened when either of the cylinder's uniform angular velocities of rotation is greater than the other. Thus the magnetohydrodynamic velocity is less than that of the classical hydrodynamic velocity in both cases. (N.W.R.)

3564 CONSERVATION LAWS AND CORRELATION FUNCTIONS. Gordon Baym and Leo P. Kadanoff (Univ. of Copenhagen). Phys. Rev., 124: 287-99(Oct. 15, 1961).

In describing transport phenomena, it is vital to build the conservation laws of number, energy, momentum, and angular momentum into the structure of the approximation used to determine the thermodynamic many-particle Green's functions. A method for generating conserving approximations was developed. This method is based on a consideration, at finite temperature, of the equations of motion obeyed by the one-particle propagator G, defined in the presence of a nonlocal external scalar field U. Approximations for G(U) are obtained by replacing the $G_2(U)$ which appears in these equations by various functionals of G(U). If the approximation for $G_2(U)$ satisfies certain simple symmetry conditions, then the G(U) thus defined obeys all the conservation laws. Furthermore, the two-particle correlation function, generated as $(\delta G/\delta U)_{U=0} \equiv \pm L$, in terms of which all linear transport can be described, will obey all the conservation laws as well as several essential sum rules, such as the longitudinal f-sum rule. Examples of conserving approximations are described. The Hartree approximation, $G_2(U) = G(U)G(U)$, generates the random-phase approximation for L. The Hartree-Fock approximation for G(U) leads to a natural generalization of the random-phase approximation in which hole-particle ladder diagrams are summed. Another conserving approximation for G(U) is obtained by expanding the self-energy to first order in the many-particle scattering matrix T(U). This T is obtained by summing ladder diagrams in which the sides of the ladder are composed of G(U)'s. The resulting L equation, which involves coefficients proportional to $|T|^2$, is analogous to the linearized version of the usual Boltzmann equation. Finally, in order to obtain a description of collisions in a plasma, the self-energy is expanded to first order in a dynamically shielded potential, $V_3(U)$. This potential is obtained by summing bubbles composed of two G(U)'s. The resulting L equation is similar in structure to a Boltzmann equation in which the collision cross section is proportional to $|V_3|^2$. (auth)

3565 SOME EFFECTS OF ANISOTROPY ON SPIRAL SPIN-CONFIGURATIONS WITH APPLICATION TO RARE-EARTH METALS. T. A. Kaplan (Massachusetts Inst. of Tech., Lexington). Phys. Rev., 124: 329-39(Oct. 15, 1961).

A theoretical study of effects of anisotropy on spiral spin-configurations is presented, emphasizing the problem of the magnetic ordering in rare-earth metals. It is shown that the ferromagnetic spiral observed at low temperatures by Wilkinson, Koehler, Wollan, and Cable in erbium can be the classical ground state of a spin Hamiltonian containing exchange and anisotropy terms, provided the latter includes terms of at least the fourth power in the spin variables. Furthermore, the observed cone angles (which imply large deviations from configurations possible with exchange forces alone) can be obtained with anisotropy forces much smaller than the exchange forces. The spin-wave spectrum and susceptibility for ferromagnetic spirals were also considered. The former has the interesting properties that $\omega(k)$ is linear in k for small k (even though the net moment is not zero), and there are two distinct branches, as contrasted with the case of simple antiferromagnetic spirals. For high temperatures, calculations are made on the basis of the molecular field approximation. It is shown that a small easy-axis anisotropy implies that at the highest transition temperature, T_c, the ordered spin configuration is a static longitudinal spin wave; the average spins are collinear, their lengths varying sinusoidally through the crystal. As T decreases below T_c, the amplitude of the wave grows in order $(T_c - T)^{1/2}$, other Fourier components entering in higher order. The perpendicular components remain zero until a second transition temperature is reached, below which they begin to order. Since this complex type of behavior, which has been observed in erbium, can also occur with the same exchange and anisotropy constants needed to give the observed ground state, the possibility exists of describing erbium through the whole temperature range by this type of theory. (auth)

3566 PHENOMENOLOGICAL DISCUSSION OF MAGNETIC ORDERING IN THE HEAVY RARE-EARTH METALS. R. J. Elliott (Oak Ridge National Lab., Tenn.). Phys. Rev., 124: 346-53(Oct. 15, 1961).

The rare-earth metals Gd–Tm have similar crystal structures and their magnetic properties were partially evaluated by a number of techniques. The magnetic order is complicated, showing several phases in some cases and differing considerably in the various elements. These orderings can be explained on a molecular field (Bragg-Williams) model if a long-range oscillatory exchange interaction whose minimum Fourier component $J(q)$ is at $q \neq 0$, small quadrupole-quadrupole interaction, and anisotropy are included. A crystal field calculation gives axial and hexagonal anisotropies which vary along the series in a way which accounts for the observed structures. In Tb, Dy, and Ho the moment is forced into the basal plane and the order is a spiral at high T, becoming ferromagnetic at low

T because of the hexagonal anisotropy. The quadrupole-quadrupole interaction determines the change of pitch with T. In Er and Tm the moment is forced along the c axis and the observed order, with sinusoidal variation of this moment, is found to have lowest free energy at high T. As T is lowered, transitions to an anti-phase domain structure and then to ferromagnetism are predicted. (auth)

3567 ELECTRON SPIN RESONANCE AND OPTICAL ABSORPTION OF ELECTRON EXCESS CENTERS IN KCl. P. R. Moran, S. H. Christensen, and R. H. Silsbee (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 124: 442-9(Oct. 15, 1961).

The effect of various conditions of optical bleaching and thermal annealing on the electron spin resonance and optical absorption of additively colored KCl was studied. With extended optical bleaching the resonance linewidth narrows and the resonance saturates less readily. The presence of R, M, N, or R′ centers is unrelated to the dominant features of the changes in resonance behavior; the optical absorption associated with the magnetic centers appears to remain in the region of the F band. (auth)

3568 MEASUREMENT OF ELECTRON SCATTERING IN CARBON TO COMPARE WITH A MUON EXPERIMENT. G. E. Masek (Univ. of Washington, Seattle), J. P. Toutonghi, R. W. Williams, and D. H. Coward. Phys. Rev., 124: 555-60(Oct. 15, 1961).

A measurement of the inelastic scattering of high-energy electrons in carbon was carried out with the express purpose of obtaining an experimental cross section to compare with a recently-completed measurement of muon scattering. A scaling law which connects the electron result with the (higher-energy) muon result is described. Results for the summed (elastic plus all inelastic) cross section at two values of the muon scattering angle are presented. At the smaller angle (momentum transfer ~200 Mev/c) agreement with the theoretical (Drell-Schwartz) sum rule is good; at the larger one (~280 Mev/c) it is poorer but within the experimental and theoretical uncertainties. No muon scattering anomaly was observed. (auth)

3569 PHASE SEPARATION IN He^3-He^4 MIXTURES NEAR ABSOLUTE ZERO. D. O. Edwards and J. G. Daunt (Ohio State Univ., Columbus). Phys. Rev., 124: 640-2 (Nov. 1, 1961).

Phase separation in liquid mixtures of He^3 and He^4 at temperatures close to 0°K is discussed on the basis of isotopic impurity models. It is predicted that for He^3-rich mixtures the phase separation line is asymptotic to the temperature axis as $T \to 0$, so that phase separation should occur in extremely dilute solutions of He^4 in He^3 at relatively high temperatures. For example, 0.003% of He^4 in liquid He^3 should begin to separate at about 0.1°K. The phase separation curve for He^4-rich mixtures near 0°K is difficult to predict with the available data. One possibility is that dilute solutions of He^3 in He^4 may be stable at 0°K. (auth)

3570 BAND STRUCTURE OF SOLID ARGON. R. S. Knox (Univ. of Rochester, N. Y. and Argonne National Lab., Ill.) and F. Bassani. Phys. Rev., 124: 652-7(Nov. 1, 1961). (AFOSR-TN-61-950)

The orthogonalized plane wave method, in a perturbation approximation, is used to compute the lowest lying conduction states in (fcc) solid argon at the symmetry points Γ, X, L, and K. The 3s and 3p valence bands are treated by tight-binding theory. The potential used in the computation consists of a sum of effective atomic potentials in which a free-electron-like expression is used for the exchange contribution. The lowest conduction state appears to be s-like (Γ_1), lying 12.4 ev above the highest valence state (Γ_{15}). The results of the computation are compared with theoretical and experimental knowledge of the electronic structure of the solid rare gases. (auth)

3571 A MAGNETO-STARK EFFECT AND EXCITON MOTION IN CdS. D. G. Thomas (Bell Telephone Labs., Inc., Murray Hill, N. J.) and J. J. Hopfield. Phys. Rev., 123: 657-65(Nov. 1, 1961).

Exciton absorption occurs, for weak exciton lines, at an energy that is the energy of an exciton having a wave vector equal to that of the light in the medium. These excitons have a finite wave vector, and therefore a finite velocity. In a uniform magnetic field, the Lorentz force on the electron and hole due to the center-of-mass velocity produces a magnetic perturbation in addition to those ordinarily considered. The measurement of such a perturbation measures the velocity of an exciton of known wave vector, and therefore determines the total exciton mass. In addition, the measurement of this effect, which depends on the exciton velocity, provides a positive distinction between exciton absorption lines and absorption lines due to impurities. It is shown that this perturbation can be measured by the measurement of the Stark effect on excitons in the presence of a uniform magnetic field. The exciton mass for the n = 2 states of excitons formed from the top valence band in CdS is measured by this technique, and found to be 0.92 ± 0.18. The Stark effect in the absence of a magnetic field is also studied to ensure an understanding of the effect in the presence of a magnetic field. The Stark effect in a magnetic field sometimes exhibits peculiar behavior, which is attributed to an extraneous Hall field. This interpretation gives an estimate of $\omega_c\tau_r \approx 2$ for electrons in "good" CdS crystals at 1.6°K and at 31,000 gauss. (auth)

3572 RELAXATION AND ACTIVATION ENERGIES FOR AN INTERSTITIAL NEUTRAL DEFECT IN AN ALKALI HALIDE LATTICE. Robert D. Hatcher (New York Univ., New York) and G. J. Dienes. Phys. Rev., 124: 726-35(Nov. 1, 1961). (BNL-5501)

A method is developed for calculating the relaxation energy for an interstitial neutral defect in an alkali halide lattice by expanding the electrostatic, polarization, and dipole-dipole energy contributions to second order in terms of the displacements of the ions from their regular positions. The repulsive energy contributions involving the defect atom are treated exactly, whereas the repulsive contributions involving the regular ions themselves are also expanded to second order. This method is applied to an interstitial chlorine atom in NaCl for positions where the defect atom is at the center of a cube of ions and at the center of a square of ions; the difference when related to the same standard configuration gives an activation energy of approximately 0.5 ev for the migration of a neutral interstitial chlorine atom in NaCl. (auth)

3573 ANHARMONIC CONTRIBUTION TO THE ENERGY OF A DILUTE ELECTRON GAS-INTERPOLATION FOR THE CORRELATION ENERGY. W. J. Carr, Jr., Rosemary A. Coldwell-Horsfall, and A. E. Fein (Westinghouse Electric Corp., Pittsburgh). Phys. Rev., 124: 747-52(Nov. 1, 1961).

The first anharmonic contribution to the ground-state energy of a body-centered cubic lattice of electrons, oscillating in a uniform background positive charge, is calculated. The result is $-0.73r_s^{-2}$ rydbergs, with r_s the radius, in Bohr units, of the sphere equivalent in volume to that occupied per electron. Combining this term with previous results gives for the ground-state energy of a dilute electron gas the expression $E = E_{exp} - 1.792r_s^{-1} + 2.65r_s^{-3/2} - 0.73r_s^{-2} + O(r_s^{-5/2})$, where E_{exp} comes from the overlapping of elec-

tronic wave functions and falls off exponentially with $r_s^{1/2}$; while the r_s^{-1} and $r_s^{-3/2}$ terms are, respectively, the Coulomb energy of a bcc lattice and the zero-point energy of the electrons. The "correlation" energy corresponding to the above expression, as well as the kinetic and potential parts, is plotted and an interpolation has been made between the low-density curve and the high-density expression of Gell-Mann and Brueckner. The interpolated curves give strong evidence that the next term in the above low-density expansion for E is approximately $-0.8r_s^{-3/2}$. If the high-density expression is rapidly converging near $r_s = 1$, it also is predicted that the r_s term in the high-density expansion will be approximately $-0.02r_s$. (auth)

3574 MEASUREMENT OF THE REFRACTIVE INDEX OF LUCITE BY RECOILLESS RESONANCE ABSORPTION. L. Grodzins and E. A. Phillips (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 124: 774-6(Nov. 1, 1961).

A method of frequency-modulating a monochromatic electromagnetic wave by varying the optical path length between the source and detector is described. The method is applied to the measurement of the refractive index of Lucite for the 0.86 A radiation from Co^{57}; the small frequency shift is detected by recoilless resonance absorption. The refractive index is found to be $1 - n = (1.29 \pm 0.03) \times 10^{-6}$, in agreement with classical theory. (auth)

3575 SPECIFIC HEAT OF SOLID He^3. E. C. Heltemes and C. A. Swenson (Ames Lab., Ames, Iowa). Phys. Rev. Letters, 7: 363-5(Nov. 15, 1961). (IS-372).

The thermal capacity of solid He^3 was measured. Data were obtained for 7-17 volumes in the alpha phase and for 10-17 volumes in the beta phase. Techniques used were checked by measuring the solid He^4 thermal capacity at 12 different volumes. A low-temperature anomaly for both He^3 and He^4 (or for the calorimeter used) was found. Data are represented graphically. (L.N.N.)

3576 MAGNETIC PROPERTIES OF He^3 AT PRESSURES NEAR THE MINIMUM IN THE MELTING CURVE. A. C. Anderson, W. Reese, and J. C. Wheatley (Univ. of Illinois, Urbana). Phys. Rev. Letters, 7: 366-7(Nov. 15, 1961).

The self-diffusion coefficient, the transverse relaxation time, and the magnetic susceptibility were measured using the spin-echo method. The longitudinal relaxation time was estimated by observing the time necessary for the magnetization to recover after being destroyed. At 28.9 atm, below P_{min}, the liquid behavior was similarly to that at lower pressures, the susceptibility being nearly constant with temperature. At 29.5 atm, slightly greater than P_{min}, the susceptibility was a factor of 2 larger than before and displayed a considerably different temperature dependence. (L.N.N.)

3577 BEHAVIOR OF STRONGLY SHOCKED CARBON. B. J. Alder and R. H. Christian (Univ. of California, Livermore). Phys. Rev. Letters, 7: 367-9(Nov. 15, 1961). (UCRL-6644-T)

Evidence is given for the conversion of graphite to the diamond phase when it is subjected to strong, explosively generated shocks. The data lend support to a further conversion at still higher pressures to a new, higher density phase, presumably the closely-packed metallic liquid. (L.N.N.)

3578 SYNTHESIS AND PROPERTIES OF AN ELECTRON-ION PLASMA. A. Von Engel and R. N. Franklin (Oxford Univ.). Proc. Roy. Soc. (London), A264: 355-66(Nov. 21, 1961).

It is shown that a low-density neutral plasma in a steady state, consisting of electrons and ions only, can be obtained by injecting opposing beams of charges into a field-free region. With the aid of electrostatic probes the electric neutrality of such a synthetic plasma can be controlled. Experiments were carried out with a plasma consisting of singly charged lithium ions of energy up to 300 ev drawn from a lithium–aluminium silicate emitter and electrons of energy 12 to 24 ev drawn from a dispenser cathode. The residual gas pressure was kept so low that collision with atoms did not contribute to the effects measured. A continuous electric signal of frequency 2 to 30 Mc/s was transmitted through the plasma. Whereas in a gaseous plasma a resonance peak at the plasma frequency was found by varying either the signal frequency or the discharge current (and thus the plasma frequency), a resonance absorption was recorded in an electron-ion plasma. This suggests that for frequencies lower than that corresponding to an individual electron crossing the region of influence of the signal the phase of the electron oscillation always tends to reduce the local field. As the electron velocity was raised the magnitude of absorption was shown to grow. The transmission in the electron-ion plasma was also studied with a magnetic field parallel to the direction of the beams which caused the electrons to circulate about the field lines. By varying the field strength the absorption was found to reach a maximum when the electron cyclotron frequency equals the plasma frequency. The width of the absorption curves for the electron-ion plasma was greater than that with an electron beam only. The interaction between ions and electrons was demonstrated by measuring the electric noise produced by the plasma. For electron energies at 10 to 70 ev the increase in noise corresponds to a change of the electron temperature at 400 to 500°K or to an average scattering angle of 1 to 3°. (auth)

3579 A MEASUREMENT OF THE IONIZATION CROSS-SECTION OF HELIUM IONS BY ELECTRON IMPACT. K. T. Dolder, M. F. A. Harrison, and P. C. Thonemann (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Roy. Soc. (London), A264: 367-78(Nov. 21, 1961).

An apparatus, based on the crossed-beam principle, is described for measuring the ionization cross-section of ions by electron impact. The cross-section for the reaction $He^+ + e \rightarrow He^{2+} + 2e$ is determined from the threshold at 54.4 to 1000 ev. The results are compared with the ionization cross-section of atomic hydrogen and with theory. The He^+ cross-section, when scaled by the appropriate factor, is very similar to that of atomic hydrogen but increases more rapidly in the neighborhood of the threshold. At the highest electron energies the cross-section agrees well with that predicted by the Coulomb-Born approximation but is considerably lower at the cross-section maximum. For electron energies above 150 ev the error in the measurement is estimated to be less than ±10%. (auth)

3580 MAGNETOHYDRODYNAMIC PRODUCTION OF ELECTRICAL ENERGY. Erling Dahlberg, Kees Hubers, and Stig Lundquist. Tek. Tidskr., 91: 85-9(Feb. 1961). (In Swedish)

The principle of the magnetohydrodynamic production of electrical energy is briefly reviewed. The conductivity of the gas, the gas generator, combustion chamber, and the air feed heater are discussed. Data for a magnetohydrodynamic power station are tabulated. (J.S.R.)

3581 ON THE METHOD OF FINITE DIFFERENCES IN QUANTUM MECHANICS. R. A. Preem. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 13, 38-66 (1961). (In Russian)

An attempt is made to construct quantum mechanics in one dimension on the basis of finite displacements. Replacing the differential operator by a difference operator indicates a possibility of using a right or left difference and further, that the state vector is a 2-spinor. An indefinite metric is introduced in this spinor space with respect to which the displacement operators in two opposite directions are hermitian conjugates. After further operations, the formalism obtained can be generalized to the case of a complex plane. Its generalization to the whole space can be effected along Weizäcker's ideas of a fundamental alternative. (auth)

3582 HIGH ORDER FOCUSING OF FLAT MONOENERGETIC ION BEAM BY HOMOGENEOUS SECTOR FIELD WITH ARBITRARY BOUNDARIES. V. R. Saulit. Vestnik Leningrad. Univ., 16: No. 10, Ser. Fiz. i Khim. No. 2, 42-54(1961). (In Russian)

The method of calculation and formulas defining the form of the sector boundaries with a homogeneous magnetic field giving exact focusing are deduced. (auth)

3583 THE EXTINCTION OF SHOCK WAVES IN INHOMOGENEOUS MEDIA. O. S. Ryzhov. Zhur. Priklad. Mekh. i Tekh. Fiz., No. 2, 15-25(Mar.-Apr. 1961). (In Russian)

The aim of the present work is to clarify basic physical principles which are applicable during the dissipation, in an inhomogeneous atmosphere, of a shock wave of a small amplitude and a narrow zone of turbulent flow. The atmosphere considered is a realistic one where the density and temperature change from point to point and where the air particles are in motion. It is shown that non-linear effects in the first approximation can be taken into account employing the method used by L. D. Landau to derive asymptotic laws for the extinction of shock waves, in homogeneous media, at large distances away from the origin of these waves. The problem is examined for both quiescent and turbulent media. The problem of the interaction of two shock waves is also examined when one of the waves is overtaking the other. It is found that the ratios of pressures for the two waves derived for this last problem apply both to homogeneous and inhomogeneous media and for waves of arbitrary form. The moment of overtake however is different. (TTT)

3584 THE EXPERIMENTAL INVESTIGATION OF SHOCK WAVES IN CLAYEY SOIL. G. M. Lyakhov and Z. V. Narozhnaya. Zhur. Priklad. Mekh. i Tekh. Fiz., No. 2, 123-6(Mar.-Apr. 1961). (In Russian)

The results of the experimental investigation of shock waves in clayey soil are described. It is shown that the shock wave parameters in clay and sandy soils are very similar for the same volumetric weight and the same degree of wetness of the soils. The experiments are carried out in a soil whose density is 1.60 to 1.65 g/cm^3 and water capacity of 6–12%. The particles' diameters are: 0.5–0.1, 0.1–0.05, 0.05–0.005, 0.005–0.001, and less than 0.001 mm, making up 20.4, 20.0, 38.0, 9.3 and 12.3% of the soil. The explosive charges consist of compressed TNT with weights of 0.2, 0.4, 0.8 and 1.6 kg. The velocity of the expansion of the wave front, the pressure, and the impulse of the shock waves are presented in diagrams as a function of a relative distance away from the explosion origin. The relative distance is defined as the distance away from the origin divided by the cube root of the weight of the charge. The results indicate the applicability of clayey and sandy soils the model of an elasto-plastic medium. (TTT)

3585 SHOCK WAVE PARAMETERS IN WATER IN THE PROXIMITY OF THE EXPLODING MATERIAL. V. N. Kostyuchenko. Zhur. Priklad. Mekh. i Tekh. Fiz., No. 2, 127-8(Mar.-Apr. 1961). (In Russian)

The determination of parameters of a shock wave close to the explosion zone was studied. The spherical charges weighed 0.85 g, had a density of 1.54 g/cm^3, and a radius R_0 of 5.1 mm. The charges were set off by an electric impulse and the shock wave front was photographed. These photographs gave the expansion radius of the front as a function of time and thus the velocity of the wave front could be determined at various distances from the explosion center. From the velocity, the pressure and other parameters were calculated. A figure is shown depicting the wave front pressure plotted as a function of distance. The pressure was found to follow the formula, $p = 80{,}000\ h^{-2}$ atm, where h is defined as the distance from the explosion center divided by the radius R_0. (TTT)

3586 FINE STRUCTURE OF THE SHOCK WAVE FRONT MOVING ACROSS THE MAGNETIC FIELD IN LOW PRESSURE PLASMA. R. Z. Sagdeev. Zhur. Tekh. Fiz., 31: 1185-91(Oct. 1961). (In Russian)

The structure of a shock wave front propagated across a transverse magnetic field in cold plasma is studied for the case in which the mean free path is larger than the mean Larmor radius. The oscillation magnitudes characterize the plasma and the field inside the front wave. The width of the front at Mach numbers less than 2 is determined by ion-electron collisions. However, it can be considerably smaller than the free path (in extreme cases by a factor of $\sqrt{m_i/m_e}$; m_e and m_i are electron and ion masses. With Mach numbers larger than 2, the width of the front does not depend on collisions. Descriptions are given of plasma instabilities developed under the described conditions. (auth)

3587 OSCILLATIONS OF PLASMA DURING ION BEAM NEUTRALIZATION. S. Ya. Lebedev, Yu. Ya. Stabisskii, I. I. Bondarenko, S. A. Maev, I. P. Stakhanov, and E. A. Stumbur. Zhur. Tekh. Fiz., 31: 1202-8(Oct. 1961). (In Russian)

Plasma oscillations induced by ion beam neutralization by electrons were studied. Due to the emission of equal numbers of electrons and ions a space filled with quasi-neutral plasma appears. To prevent the accumulation of charge on electrodes it is assumed that under stationary conditions the total plasma current is zero. It is also assumed that the current passing each emitting surface area is also zero. In order to find the results produced by the above conditions a problem is set up in which electrons and ions are emitted orthogonally, at rates v_{10} and v_{20}, to a conducting plane surface which coincides with the plane $x = 0$. An analysis is made of the stationary state in a coordinate system related to the emitting surface. (R.V.J.)

3588 ON THE TYPE OF INSTABILITY IN BEAM AND PLASMA INTERACTIONS IN EXTERNAL MAGNETIC FIELD. A. B. Kitsenko (Khar'kov Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Tekh. Fiz., 31: 1210-11(Oct. 1961). (In Russian)

Investigations were made of high-frequency electron longitudinal oscillations excited by a charged particle beam passing through plasma in an external magnetic field. It is shown that the instability caused by the beam passage is of a convective type. (R.V.J.)

3589 ON INSTABILITY AND AMPLIFICATION CRITERIA. R. V. Polovin (Inst. of Physics and Tech., Acad-

emy of Sciences, Ukrainian SSR). Zhur. Tekh. Fiz., 31: 1220-30(Oct. 1961). (In Russian)

The general criteria of absolute and convective instability and amplification are analyzed. The criteria are used in an investigation of electron beam motion in a retarding system of crossed electric and magnetic fields. (tr-auth)

3590 ON FINITE WAVE AMPLITUDES IN NON-IDEAL MAGNETOHYDRODYNAMICS. V. S. Tkalich and N. V. Saltanov. Zhur. Tekh. Fiz., 31: 1231-5(Oct. 1961). (In Russian)

A system of equations for nonideal magnetohydrodynamics with physical magnitude dependence on a single coordinate and time was reduced to two independent linear scalar equations for vector potential components. The physical magnitudes in their finite appearance are expressed by vector potential; the principle of superposition is emphasized and correlated with published data. The eigen-oscillations (finite amplitudes) of a hydromagnetic resonator are analyzed. A finite-amplitude wave traveling along a magnetic field is studied, and the effects of conductivity, viscosity, and other parameters are determined. (tr-auth)

3591 ELECTROMAGNETIC WAVES IN A SYSTEM OF SELF-PENETRATING PLASMAS. A. A. Rukhidze (Lebedev Inst. of Physics, Moscow). Zhur. Tekh. Fiz., 31: 1236-45 (Oct. 1961). (In Russian)

An analysis is made of electromagnetic waves in a system consisting of an unrestricted plane parallel beam of charged particles in motion at an arbitrary relativistic rate $\underline{u}$ in a stationary isotropic plasma. The conditions of instability and the increment of increasing oscillations were found. It is shown that the oscillation time increases in the high-frequency region and in the low-frequency region, where a spatial dispersion of electric penetrability is essential. Moreover, increasing oscillations are possible in the low-frequency region at a beam rate $\underline{u}$ smaller than the thermal rate of particles in the system. (tr-auth)

3592 RAREFIED GAS DYNAMICS. Proceedings of the Second International Symposium on Rarefied Gas Dynamics, Berkeley, California, in 1960. L. Talbot, ed. Advances in Applied Mechanics. Supplement 1. New York, Academic Press, 1961. 761p. $19.00.

Forty-one papers are presented on the subjects of kinetic theory, high altitude hypersonics, free molecular flow, gas-surface interactions, and low density ionized gas phenomena. (N.W.R.)

3593 INFRARED. PART II. INFRARED SPECTROSCOPY. OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). May 1961. 11p. (SB-467). $0.10(OTS).

A bibliography on infrared spectroscopy is presented. The 185 references added to the Office of Technical Services' collection during the period 1950 to June 1961 are listed. (M.C.G.)

3594 THERMODYNAMIC PROPERTIES OF LIQUID ^{3}He–^{4}He MIXTURES. R. de Bruyn Ouboter. Thesis, Leiden, Universiteit, 1961. 66p.

The existing vapor–liquid equilibrium data on He^3-He^4 mixtures are analyzed. Heat capacities of He^3- He^4 mixtures over the complete concentration range are measured using a calorimeter that can be cooled down to 0.4°K by means of evaporation of He^3. Some thermodynamic considerations on the properties of liquid He^3-He^4 mixtures are given. The entropy of dilute mixtures is discussed with respect to Nernst's theorem. (NPO)

3595 THERMOELECTRICITY: SCIENCE AND ENGINEERING. Robert R. Heikes and Roland W. Ure, Jr. New York, Interscience Publishers, 1961. 584p.

The various aspects of thermoelectricity are studied in regard to energy conversion and production. The following topics are covered: the physics and chemistry of thermoelectric materials, the design of materials, and the device technology. A discussion is given of the thermoelectric effects in classical semiconductors in order to give some physical insight into thermoelectric phenomena. Applications of thermoelectricity are also discussed. (N.W.R.)

Astrophysics and Cosmology

3596 (ML-863) ELECTRODYNAMIC PROBLEMS OF ASTROPHYSICS. Technical Status Report No. 4, July 1–September 30, 1961. P. A. Sturrock (Stanford Univ., Calif. W. W. Hansen Labs. of Physics). Nov. 1961. Contract AF49(638)-342. 7p.

Instabilities in plasmas caused by anisotropy of velocity distribution in components are considered. It is thought possible that the instability may underlie the process of shock formation which is believed to be responsible for Type II radio bursts. In studies of the interaction of fluid motion and magnetic fields in stars a model for steady-state circulation in the presence of a poloidal magnetic field was developed. In other development, a systematic procedure for constructing approximate solutions to the free-boundary problem in interactions between the geomagnetic field and the interplanetary gas streaming outward from the sun was studied. (J.R.D.)

3597 THE SOLAR WIND. E. N. Parker (Univ. of Chicago). J. Research Natl. Bur. Standards, 65D: 537-42 (Nov.-Dec. 1961).

Hydrodynamic expansion of the solar corona is the basis for solar corpuscular radiation. The quiet day coronal temperatures of 1 to 2×10^6 °K yield a solar wind of several hundred km/sec and a density of 5 to 50 particles/cm^3 at the orbit of Earth. The solar wind draws out into space the lines of force of the general one-gauss solar field, to give an interplanetary field that is basically spiral in character with a density of the order of a few times 10^{-5} gauss at the orbit of Earth. The enhanced corona may sometimes have temperatures of 4×10^6 °K or more immediately following a large flare. Such explosive heating leads to a 1 to 2×10^3 km/sec blast wave into planetary space. The blast wave sweeps up the quiet-day solar wind ahead and kinks the quiet-day field, raising the density of the field to several times 10^{-4} gauss on some occasions. The galactic cosmic ray particles are swept back by the kink, producing a Forbush-type intensity decrease. Altogether, the blast wave and its magnetic field constitute the enhanced solar corpuscular radiation. It is shown that the alternative magnetic tongue model of Gold and others [1960] is untenable because the tongue would not reach the earth until many hours after the arrival of the blast wave. (auth)

Cosmic Radiation

3598 (AD-257272) A NOTE ON THE RBE OF PROTON RADIATION IN SPACE. Report No. 18. Hermann J. Schaefer (Naval School of Aviation Medicine, Pensacola, Fla.). 1961. 13p.

The energy spectrum of ionizing particles in the inner Van Allen belt and of flare-produced protons were analyzed as a function of their biological effects on a human target. Evaluation of the intratarget energy and linear energy

transfer spectra of the fluxes and interpretation in terms of relative biological effects (RBE) shows that proton beams in space, contrary to recoil protons from fission neutrons, contain only a small fraction of low-energy particles. As a consequence, the RBE factor remains below 1.5. Significantly higher RBE values can occur only in the surface of freely exposed targets. (C.H.)

3599 THE HISTORY OF COSMIC RAYS. W. F. G. Swann (Franklin Inst., Swathmore, Penna.). Am. J. Phys., 29: 811-16(Dec. 1961).

This history of developments in the cosmic-ray field is traced back to the time when there was uncertainty about the origin of ionization in closed vessels. The era then passes through the period when, through the high-altitude experiments of Victor F. Hess, the existence of a radiation coming from outside the atmosphere was accepted. The controversy as to whether the rays are photons or charged particles is sketched and leads through the results of geomagnetic effects to the conclusion that the primaries are positively charged particles, mostly hydrogen, but that in addition there is about 15% of helium, and representatives of probably all elements are to be found in amounts diminishing with increase of atomic number. The effect on the detailed study of cosmic ray phenomena of the discovery of the mesotron and the positron is traced, as is the part played by such theoretical discoveries as pair production. Brief reference is made to large showers, the origin of the primary cosmic radiation, and the part played by island magnetic fields existing in the galaxy and solar system. (auth)

3600 AN EXTERNAL RADIATION BELT AT A HEIGHT OF 320 KM ABOVE THE EARTH. S. N. Vernov, I. A. Savenko, P. I. Shavrin, V. E. Nesterov, and N. F. Pisarenko (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 140: 787-90(Oct. 1, 1961). (In Russian)

The orbit of the second Russian sputnik was almost circular with altitude extremes of 307 and 339 km. The count rate obtained from a scintillation counter [NaI (Tl) crystal] on board the sputnik showed an increase from 4 to 11 disinteg/cm^2-sec on going from the equator to latitudes of ±40 to 50° due to the variation in cosmic ray count with latitude. Then, a sharp increase in count rate of 20–600 disinteg/cm^2-sec was observed at geometrical latitudes of 50 to 65°. Conjugate points were determined, where a zone of increased activity in Siberia was related with a region in the South Indian Ocean, and a zone in North America was related with a zone in the South Pacific Ocean. Thus, zones of increased radiation in the Northern Hemisphere were related to corresponding zones in the Southern Hemisphere by means of the force lines of the geomagnetic field which determines the external radiation belt. The limit of the radiation belt at small latitudes corresponds with the isocline $\delta = 70°$ in the Northern Hemisphere and with $\delta = 66°$ in the Southern Hemisphere. The radiation was found to be due to γ rays having an energy of 100 to 300 kev which originated from the slow-down of electrons hitting the shell of the sputnik. It was estimated that the upper limit of the lifetime of the electrons in the belt was 10^6 to 10^8 seconds. Hence it is more likely that the electrons are captured by local acceleration of electrons within the limits of the geomagnetic field than in accordance with a neutron hypothesis. (TTT)

3601 FORMATION OF THE GEOMAGNETIC STORM MAIN-PHASE RING CURRENT. A. J. Dessler, W. B. Hanson, and E. N. Parker (Lockheed Missiles and Space Co., Palo Alto, Calif.). J. Geophys. Research, 66: 3631-7(Nov. 1961).

It is suggested that hydromagnetic waves generated by the impact of solar plasma on the geomagnetic field may form shock waves in the magnetosphere, thus providing a mechanism for establishing the diamagnetic main-phase ring current. These shock waves should develop on the night side of the earth and heat the ambient protons (which constitute the normal protonosphere) to approximately the hydromagnetic-wave velocity (of the order of 500 km/sec). The transfer of hydromagnetic-wave energy to the protons stresses the geomagnetic field and produces the geomagnetic-storm main phase; i.e., the kilovolt-energy protons form a diamagnetic current. The bombardment of the upper atmosphere by energetic hydrogen atoms from the decaying ring current and the possible change in the decay time-constant of the ring current through the sunspot cycle are discussed. (auth)

3602 SPATIAL DISTRIBUTION OF ELECTRONS FROM NEUTRON DECAY IN THE OUTER RADIATION BELT. W. N. Hess and J. Killeen (Univ. of California, Livermore). J. Geophys. Research, 66: 3671-80(Nov. 1961). (UCRL-6347-T)

The spatial distribution of electrons injected into the geomagnetic field from the beta decay of cosmic-ray-produced neutrons leaking out of the atmosphere was calculated. There is available an IBM 709 code which is used to calculate the densities of particles trapped by the geomagnetic field for both natural and artificial sources. The spatial distribution of electrons from the neutron decay source in the inner belt was presented previously. In that calculation losses due to atmospheric scattering were included. In this calculation atmospheric scattering is neglected above 2000 km; but the effect on the mirror-point distribution of slowing down of the electrons is included. These results are compared with some observed spatial distributions of electrons. (auth)

3603 COORDINATES FOR MAPPING THE DISTRIBUTION OF MAGNETICALLY TRAPPED PARTICLES. Carl E. McIlwain (State Univ. of Iowa, Iowa City). J. Geophys. Research, 66: 3681-91(Nov. 1961).

Dipole representations of the earth's magnetic field have insufficient accuracy for the study of magnetically trapped particles. A coordinate system consisting of the magnitude of the magnetic field B and the integral invariant I was organized adequately, measurements made at different geographic locations. A parameter L = f(B,I) is defined that retains most of the desirable properties of I and that has the additional property of organizing measurements along lines of force. Since the parameter L is the analog of a physical distance in a dipole field (the equatorial radius of a magnetic shell), it usually presents fewer conceptual difficulties than the integral invariant I. (auth)

3604 THE PRIMARY COSMIC-RAY ELECTRON FLUX DURING A FORBUSH-TYPE DECREASE. Peter Meyer and Rochus Vogt (Univ. of Chicago). J. Geophys. Research, 66: 3950-2(Nov. 1961).

Results bearing on the question of whether cosmic electrons have a solar or a galactic origin are reported. These results concern electron production at the sun during the September 3, 1960, solar flare, which produced a large flux of high-energy protons, and the short-term intensity variation of primary electron flux during a Forbush-type decrease. Evidence points to a galactic origin, but does not exclude the possibility of solar emission with subsequent, temporary storage in interplanetary space at other times. (L.N.N.)

3605 ON HIGH ENERGY NEUTRINO PHYSICS IN COSMIC RAYS. M. A. Markov and I. M. Zheleznykh (Lebedev Inst. of Physics, Academy of Sciences, Moscow). Nuclear Phys., 27: 385-94(1961). (In English)

Detection of high-energy cosmic neutrinos in underground experiments is discussed. Problems of high-energy neutrino physics are discussed, viz. the magnitude of weak-interaction cut-off momentum, muon and electron neutrinos and intermediate boson. It is shown that a reasonable counting rate could be obtained with available equipment. (auth)

3606 DOUBLE CLOUD-CHAMBER INVESTIGATION OF 500 m_e PARTICLES IN COSMIC RAYS. Alfred Z. Hendel (Univ. of Michigan, Ann Arbor), Pierre A. Piroué, and George T. Reynolds. Phys. Rev., 124: 580-3(Oct. 15, 1961).

The Princeton double cloud chamber was used to investigate the mass spectrum of long-lived cosmic particles between the μ-meson and the proton masses. It was operated at Echo Lake, Colorado (3250 m altitude and 42° geomagnetic latitude) and at Princeton, New Jersey (sea level). The upper cloud chamber operated in a magnetic field of 5500 gauss. The lower chamber contained 7 copper plates of 1.27 cm thickness each. The range of a stopping particle was between 120 and 200 g/cm^{2}Cu equivalent. No production layer was used. At Echo Lake a water Cerenkov counter was included in the counter arrangement to bias against μ mesons. The mass of every stopping particle was determined from momentum and range. A measurement of the ionization by droplet counting was possible in the upper chamber. No particle of about 500 electron masses was found in either run as compared to an equivalent flux of about 1000 stopped μ mesons at Echo Lake and 1500 stopped μ mesons at Princeton. These results are in disagreement with the Alikhanian experiment. (auth)

3607 ON THE METHODS FOR SEARCHING LOCAL SOURCES OF HIGH ENERGY PHOTONS. G. T. Zatsepin and A. E. Chudakov (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 41: 655-9(Aug. 1961). (In Russian)

Cherenkov radiation produced by an atmospheric shower was utilized for recording showers of primary photons with $E \sim 10^{12}$ ev at solid angle of $\sim 10^{-3}$ sterad. (R.V.J.)

Criticality Studies

Refer also to abstract 3856

3608 (CEND-145) LIFETIME CHARACTERISTICS AND ECONOMICS AND ECONOMICS OF SLIGHTLY ENRICHED URANIUM DIOXIDE IN WATER LATTICES. Final Report [on] STUDY OF SLIGHTLY-ENRICHED URANIUM–WATER LATTICES WITH HIGH CONVERSION RATIO. J. Bengston, J. M. Ravets, and R. J. Rickert (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Sept. 30, 1961. Contract AT(30-1)-2379. 31p.

The fairly general use of C. H. Westcott's scheme for obtaining one-group effective cross sections especially for calculating long-term reactivity changes for low enriched uranium-fueled reactors motivated a comparison with another commonly used method, namely, MUFT and SOFOCATE. The apparently better agreement with plutonium critical experiments that Westcott's method yields is traced to his better Pu^{239} thermal cross sections. The limitations of his method for drier and hence more epithermal spectrum cores is analyzed. Suggestions for improving the SOFOCATE, and in particular the CANDLE cross sections, are made. The practical effect of Westcott's method in predicting increased long-term reactivity is illustrated. It was concluded that Westcott's scheme is adequate for well-moderated reactors but that his epithermal α values are too optimistic and hence for drier lattices the MUFT-SOFOCATE method should be used. (auth)

3609 (KAPL-2172) THERMAL AND RESONANCE FISSION-PRODUCT POISONING FOR U^{235} SYSTEMS. C. R. Greenhow and E. C. Hansen (Knolls Atomic Power Lab., Schenectady, N. Y.). Oct. 19, 1961. Contract W-31-109-Eng-52. 35p.

A generalized analysis is presented of fission-product poisoning. The analysis generates values for thermal, resonance, and total fission-product poisoning as a function of the energy cutoff of the thermal group, E_c; the energy cutoff of the resonance group, E'_c; moderator temperature, T; special index, $\beta\gamma = \Sigma_a(kT)\xi\Sigma_s$; and fractional fuel depletion, β. The results are presented in terms of a fission-product 2200 m/sec absorption cross section and fission-product resonance integral. It is thus possible to predict correctly the thermal, resonance, and total fission-product poisoning, throughout core life, in a form convenient for integration with any arbitrary few-group depletion scheme. (auth)

3610 (KAPL-M-JJS-3) REACTIVITY COEFFICIENTS IN THE UNPOISONED PMA-40 SLAB CORE. PART II. ANALYSIS. James J. Schultheis (Knolls Atomic Power Lab., Schenectady, N. Y.). Oct. 2, 1961. Contract W-31-109-Eng-52. 28p.

Analysis was made of the PMA-40 slab core experiments described in KM-JJS-2. These experiments were performed with the explicit purpose of obtaining data that could be used in evaluating different methods of generating cross sections. The analytical and experimental results are utilized in a partial evaluation of two cross-section routines used to determine multigroup constants, WOXX and MUFT-SOFOCATE. In addition to reactivity coefficient calculations, analytical flux distributions, reflector savings, and fuel self-shielding are also compared to the experimental values. (auth)

3611 (NASA-TN-D-1102) CONSISTENT P1 ANALYSIS OF AQUEOUS URANIUM-235 CRITICAL ASSEMBLIES. Daniel Fieno (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Nov. 1961. 49p.

The lethargy-dependent equations of the consistent P1 approximation to the Boltzmann transport equation for slowing down neutrons were used as the basis of an IBM 704 computer program. Some of the effects included are linearly anisotropic center of mass elastic scattering, heavy element inelastic scattering based on the evaporation model of the nucleus, and optional variation of the buckling with lethargy. The microscopic cross-section data developed for this program covered 473 lethargy points from lethargy u = 0 (10 Mev) to u = 19.8 (0.025 ev). The value of the fission neutron age in water was calculated to be 26.5 square centimeters; this value was compared with the recent experimental value given as 27.86 square centimeters. The Fourier transform of the slowing-down kernel for water to indium resonance energy calculated compared well with the Fourier transform of the kernel for water as measured by Hill, Roberts, and Fitch. This method of calculation was applied to uranyl fluoride–water solution critical assemblies. Theoretical results established for both unreflected and fully reflected critical assemblies were compared with available experimental data. The theoretical buckling curve derived as a function of the hydrogen to U^{235} atom concentration for an energy-

independent extrapolation distance was successful in predicting the critical heights of various unreflected cylindrical assemblies. The critical dimensions of fully water-reflected cylindrical assemblies were reasonably well predicted using the theoretical buckling curve and reflector savings for equivalent spherical assemblies. (auth)

3612 CALCULATION OF THE NEUTRON LEAKAGE SPECTRA AND NEUTRON DOSES FROM BARE CRITICAL SYSTEMS. J. R. Knight (Oak Ridge Gaseous Diffusion Plant, Tenn.). Nuclear Sci. and Eng., 11: 239-45(Nov. 1961).

Due to the interest in determining the dose received by persons near a criticality accident, a method for calculating the neutron spectra and neutron dose for highly enriched uranium solutions at various hydrogen to U^{235} atomic ratios is developed. This method uses the output from a code for criticality calculations, and determines the average leakage neutron energy, the neutron leakage spectrum, the first collision neutron dose, and the total neutron dose. The results of these calculations show that the average energy of the leakage neutrons and the dose per incident leakage neutron per cm^2 decrease somewhat with increased hydrogen to U^{235} atomic ratio, but it appears that this effect is sufficiently small so that an exact knowledge of the uranium concentration would not be necessary to obtain reasonable dose estimates. The effect of neutron scattering on the neutron spectra and doses is not evaluated. No attempt is made to describe actual dose determination methods, since these are adequately described elsewhere. (auth)

3613 INTERACTION OF SEPARATED FISSIONABLE SYSTEMS. PART I. Floro Miraldi and Melville Clark, Jr. (Massachusetts Inst. of Tech., Cambridge). Nuclear Sci. and Eng., 11: 246-55(Nov. 1961).

The critical parameters of coupled fissionable assemblies in close proximity to one another are studied by differential equations for the conservation of neutrons. The coupling between the assemblies is taken into account by the use of approximate boundary conditions derived from expressions for the average neutron flow between the assemblies. Critical equations are found from the one and two group diffusion theories and from the P_3 approximation. The results are compared with existing experimental data. The methods are especially suited to the study of arrays of prisms. (auth)

3614 INTERACTION OF SEPARATED FISSIONABLE SYSTEMS. PART II. Floro Miraldi and Melville Clark, Jr. (Massachusetts Inst. of Tech., Cambridge). Nuclear Sci. and Eng., 11: 256-62(Nov. 1961).

The critical parameters of coupled fissionable assemblies in close proximity are studied by a variational technique based upon an integral equation for neutron conservation. Both diffusion and transport kernels can be used, and though the former is simpler, it may lead to considerable error in certain cases. An iterative method is used to solve the resulting integral equation for the case of identical spheres. The rapid convergence implies that a constant trial function for the flux is satisfactory. It is found that limiting values are rapidly approached as the separation increases and that the effect is more pronounced if the assemblies are in a vacuum than if they are embedded in matter. (auth)

3615 RATIO OF FUNDAMENTAL AND SECOND ORDER HARMONICS IN FLUX FOR OSCILLATOR EXPERIMENTS WITH VARYING AMPLITUDE OF REACTIVITY INSERTION. Henry A. Sandmeier (Argonne National Lab., Ill.). Nuclear Sci. and Eng., 11: 339-40(Nov. 1961).

In designing oscillator rods it is important to know where the limit in terms of reactivity lies if one is to be assured of a linear response. Hence, pertinent expressions are extracted to obtain the amplitude ratio of second order harmonic and fundamental with varying amplitude of reactivity insertions. These equations are applicable to any reactor provided the linear frequency response is known over a range equal to twice the nonlinear range of interest. This derivation is only valid for varying amplitude considerably below prompt critical. Furthermore, the frequencies should not be too high in order to avoid the appearance of spatial modes in the flux. In this analysis all the data necessary to obtain information on nonlinear behavior are linear. (N.W.R.)

Elementary Particles and Radiations

3616 (TID-14188) NONADIABATIC PARTICLE MOTION IN AXISSYMMETRIC FIELDS. [Period Covered], September–October 1961. George Schmidt (Stevens Inst. of Tech., Hoboken, N. J.). Contract AT(30-1)-2813. 34p. (SIT-P48)

The motion of charged particles in electromagnetic fields under extremely nonadiabatic conditions, e.g., in a region of vanishing magnetic field either in space or in time, is investigated. The constancy of the canonical angular momentum in axisymmetric fields was used to treat this case. Strict laws for flux conservation are derived for arbitrary changes of fields in space and time. Particle injection into cusped geometries is studied and compared to experimental results. Particle motion under magnetic field reversal in time is investigated and compared to findings in θ-pinch experiments under field reversal. A simple self-consistent model for particle motion under field reversal is developed which leads to the automatic formation of an E-layer as a consequence of field reversal. (D.L.C.)

3617 (JPRS-8937(p.10-27)) ON THE BRANCHING RATIOS OF THE DECAYS OF THE HYPERONS AND K-MESON AND THE RATIOS OF THE MEAN LIFE TIMES. Chung-mu Ch'en, Tsu-shiu Ho, Ting-ch'ang Hsien, and Hung-yuan Chu. Translated from Wu Li Hsüeh Pao, 15: No. 2, 63-75(Feb. 1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract no. 15589.

3618 (JPRS-8937(p.28-42)) ANGULAR DISTRIBUTION OF THE DECAY PRODUCTS OF HYPERONS. Chung-mu Ch'an, Tsu-hsiu Ho, Ting-ch'ang Hsien, and Hung-yuan Chu. Translated from Wu Li Hsüeh Pao, 15: No. 2, 77-87(Feb. 1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract no. 15590.

3619 THE SCATTERING OF X RAYS AS PARTICLES. A. H. Compton (Washington Univ., St. Louis). Am. J. Phys., 29: 817-20(Dec. 1961).

The experimental evidence and the theoretical considerations that led to the discovery and interpretation of the modification of the wavelength of x rays as a result of scattering by electrons are reviewed, as is the controversy between Duane and the author that took place in 1923 to 24. The confirmatory evidence obtained by Bothe, Geiger, Simon, and Compton is summarized. (auth)

3620 EARLY WORK ON THE POSITRON AND MUON. C. D. Anderson (California Inst. of Tech., Pasadena). Am. J. Phys., 29: 825-30(Dec. 1961).

Early work on the positron and muon is described in an

informal way, with emphasis on those aspects of the work which normally would not find their way into the literature. (auth)

3621 ON THE CONNECTION BETWEEN SPIN AND STATISTICS. G. F. Dell'Antonio (Northwestern Univ., Evanston, Ill.). Ann. Phys. (N. Y.), 16: 153-7(Nov. 1961).

It is proven that the axioms of field theory are not compatible with a different assignment of (anti-)commutation relations to a field and its Hermitian conjugate. As a corollary it is shown that if it is required that a field $\psi(x)$ either commute or anticommute with itself at space-like distances, commutation relations must be chosed if ψ transforms according to a single-valued irreducible representation of the Lorentz group; anticommutation relations if ψ transforms according to a double-valued representation. (auth)

3622 ON THE INFLUENCE OF CORRELATION OF THE ATOMIC ELECTRONS ON THE ELASTIC ELECTRON SCATTERING BY HELIUM ATOMS. W. Kołos and K. Pecul (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Ann. Phys. (N. Y.), 16: 201-4(Nov. 1961).

The differential cross section for elastic scattering of electrons by helium atoms was calculated using 2-, 3-, and 6-term Hylleraas wave functions, and analytical approximations to self-consistent field wave functions. The latter gave reliable results which in the case of short expansions can be better than those obtained using Hylleraas wave functions with the same number of parameters. (auth)

3623 ON THE INELASTIC SCATTERING OF MESONS BY DEUTERONS. Erasmo M. Ferreira (Centro Brasilerio de Pesquisas Fisicas, Rio De Janeiro). Ann. Phys. (N. Y.), 16: 235-62(Nov. 1961).

The formal expression for the scattering operator for meson-deuteron inelastic scattering is expanded in terms of two-particle scattering operators. The terms of this expansion which represent first- and second-order processes are explicitly evaluated and discussed. Coulomb interaction of two protons in the final state is treated. Formulas for cross sections for inelastic (without charge exchange) and charge-exchange meson-deuteron scattering are given. (auth)

3624 DECAY RATE OF BOUND MUONS. Robert W. Huff (Univ. of Chicago and Carnegie Inst. of Tech., Pittsburgh). Ann. Phys. (N. Y.), 16: 288-317(Nov. 1961).

The total rate and the electron energy spectrum are calculated for decay of a negative muon bound in an atomic 1s state, using relativistic electron and muon wave functions appropriate to an extended nuclear charge distribution and using a general local, nonderivative, decay interaction. The rate and the spectrum are computed numerically for iron, antimony, lead, and uranium, and the rate is found to be in qualitative agreement with earlier calculations. The results are compared with experiment after approximate corrections are made for energy loss by the decay electrons in the target, and for the detection threshold for these electrons. These corrections are found to explain the great reduction in the experimental ratio of bound to free muon decay rates for heavy elements, thus removing the previous theoretical-experimental discrepancy for these elements. The observed peak in the bound muon decay rate near iron is not predicted, but a consideration of possible additional contributions to the experimental decay rate suggests that the large background of low-energy gamma rays associated with the accompanying muon capture might be connected with this peak. (auth)

3625 TRANSITION CURVES IN LEAD FOR μ-MESON INDUCED SHOWERS. Margaret D. Wilson and I. B. McDiarmid (National Research Council, Ottawa). Can. J. Phys., 39: 730-2(Nov. 1961). (NRC-6533)

A cloud chamber experiment was designed to study electromagnetic interactions of high-energy cosmic mesons (μ). A family of transition curves was obtained for the resulting showers. An 80-cm block of lead above the chamber removed essentially all the incident particles except muons at greater than 1.2 Bev. It was found that after the initial rapid increase with increasing thickness of lead, the probability for burst production increases slowly with thickness. No definite indication of a second maximum near 15 m was found. (L.N.N.)

3626 THE LIFETIMES OF POSITRONS IN METALS. G. Jones and J. B. Warren (Univ. of British Columbia, Vancouver). Can. J. Phys., 39: 1517-27(Nov. 1961).

The lifetimes of positrons annihilating in 21 metals were measured comparatively with the lifetime in aluminum. Significant variations were found, as large as 30% of the absolute lifetime in aluminum, and the lifetime shows a more marked dependence on the atomic density than on the valence electron density of the metal. By comparison of lifetime and angular distribution data a mechanism of the annihilation process is proposed. In metals with large lattice spacings the annihilation is primarily with valence electrons, but slightly enhanced by pick-off annihilations with outer electrons of the ions; as the spacing decreases the pick-off probability increases, resulting in larger high momentum tails to the parabolic angular distributions and shorter lifetimes. The annihilation rate increases with valence electron density but levels off at higher densities at a rate similar to the theoretical value for positronium ions. With very reduced lattice spacing the annihilation with ionic electrons becomes comparable with that with valence electrons, so that bell-shaped angular distributions and shorter lifetimes result. (auth)

3627 TALMI TRANSFORMATIONS FOR PARTICLES WITH DIFFERENT MASSES. Yu. F. Smirnov (Moscow State Univ.). Nuclear Phys., 27: 177-87(1961). (In English)

A general formula for Talmi coefficients is obtained, making it possible to pass from the wave functions of two particles having different masses μ_1 and μ_2 moving in the oscillator potential $V(r_1,r_2) = \frac{1}{2}\mu_1\omega r_1^2 + \frac{1}{2}\mu_2\omega r_2^2$ to the wave functions describing the relative motion of these particles and the motion of their center of mass. These coefficients are necessary for isolating the motion of the center-of mass of several nucleons in the shell model. They are also applied in calculating the energy matrix, etc. (auth)

3628 INELASTIC PROTON SCATTERING ASYMMETRIES AT 8.9 MEV. A. Budzanowski, R. W. Clifft, and B. Hird (Univ. of Liverpool). Nuclear Phys., 27: 193-203(1961). (In English)

Asymmetry in inelastic scattering of a polarized proton beam from a magnesium target was measured at a number of angles and at three different energies. A comparison between the inelastic asymmetries and the corresponding elastic asymmetries shows that in all cases, they have opposite signs. (auth)

3629 ANTIPROTON-PROTON INELASTIC INTERACTIONS AT 1.61 Bev/c AND THEIR USE FOR A TEST OF CHARGE-CONJUGATION INVARIANCE IN STRONG INTERACTIONS. Nguyen-huu Xuong, Gerald R. Lynch, and C. Keith Hinrichs (Univ. of California, Berkeley). Phys. Rev., 124: 575-9(Oct. 15, 1961). (UCRL-9673)

The reactions $\bar{p} + p \rightarrow \bar{p} + p + \pi^0$, $\bar{p} + n + \pi^+$, and $p + \bar{n} + \pi^-$ are investigated for antiprotons of 1.61 Bev/c. The

cross sections are measured and found to be 1.6 ± 0.3 mb, 1.15 ± 0.3 mb, and 0.96 ± 0.22 mb, respectively. The combined inelastic (nonannihilation) cross section is estimated to be 5.3 mb, and the annihilation cross section 51 ± 3 mb. The angular and energy distributions are presented. In all cases the antinucleons are peaked forward and the nucleons backward in the center-of-mass system. These events can be used to check charge-conjugation invariance in strong interactions. (auth)

3630 SHAPE-INDEPENDENT THEORY OF HIGH-ENERGY NUCLEON-NUCLEON SCATTERING. Louis A. P. Balázs (Univ. of California, Berkeley). Phys. Rev., 124: 602-11(Oct. 15, 1961). (UCRL-9834)

A shape-independent formula for nucleon-nucleon phase shifts, approximately valid over wide energy ranges is derived, assuming only general properties of the wave function and potential. It is found to approximately reproduce the S, P, and D proton-proton phase shifts in the ranges 10 to 150 Mev and 10 to 310 Mev with two, or at most three, free parameters per state. A generalization, which includes part or all of the outer potential exactly, is derived at the same time. (auth)

3631 $\Sigma-\Lambda$ RELATIVE PARITY AND THE $\Sigma^0 \rightarrow \Lambda^0 + \gamma + \gamma$ DECAY. S. Chiba (Kanazawa Univ., Japan), S. Oneda, and J. C. Pati. Phys. Rev., 124: 611-14(Oct. 15, 1961).

It is shown that the π^0-pole term predicts a large difference by nearly two to three orders of magnitude for the branching ratio of the $\Sigma^0 \rightarrow \Lambda^0 + 2\gamma$ decay mode, depending upon the value of the $\Sigma-\Lambda$ relative parity. It is further argued that this difference is not masked, even if we include other diagrams. It is thus suggested that a study of the branching ratio of the $\Sigma^0 \rightarrow \Lambda^0 + 2\gamma$ decay may serve to determine the $\Sigma-\Lambda$ relative parity. (auth)

3632 RANGE OF THE NUCLEON-ANTINUCLEON ANNIHILATION POTENTIAL. A. Martin (CERN, Geneva). Phys. Rev., 124: 614-15(Oct. 15, 1961).

It is shown that the assumption of the validity of the Mandelstam representation for nucleon-antinucleon scattering leads to a potential, fitting the data at a given energy, with an imaginary part, the range of which cannot exceed half the nucleon Compton wavelength. (auth)

3633 DECAY MODES OF K*. M. A. B. Bég, P. C. DeCelles, and R. B. Marr (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 124: 622-3(Oct. 15, 1961). (BNL-5502)

Using strong selection rules alone, the principal decay channels for the Kπ resonance (K*) are enumerated. It is pointed out that the reactions $K^* \rightarrow K + \gamma(e^+ + e^-)$ and $K^* \rightarrow K + 2\pi$ determine the spin on qualitative grounds alone. A plausible estimate is made of the radiative width ($\Gamma_{K+\gamma} \sim 10^{-2}\Gamma_{K+\pi}$). Experiments are suggested which may shed some light on the electromagnetic coupling of the K*K system. (auth)

3634 BOUND-STATE MODEL OF WEAK AND STRONG INTERACTIONS. C. H. Albright, R. Blankenbecler, and M. L. Goldberger (Princeton Univ., N. J.). Phys. Rev., 124: 624-36(Oct. 15, 1961).

The pion-nucleon coupling constant is calculated from first principles by use of the N/D matrix method. Three models are introduced which contain pions, nucleons, and weakly interacting intermediate bosons of the scalar, pseudoscalar, and vector variety. The basic interactions are taken to be parity and isotopic spin conserving. Certain physical assumptions in the nature of boundary conditions and the known fact that the weak coupling is very weak, together with use of the Born approximation for N, enable us to obtain an eigenvalue equation which expresses the pion-nucleon coupling constant in terms of the three masses in the problem. The correct value for g_{π^2} can be obtained for an intermediate vector meson of mass comparable to the nucleon mass with essentially no cutoff employed; on the other hand, the experimental value is also obtained with a spin-zero boson and a relatively small cutoff energy. (auth)

3635 LEFT-RIGHT ASYMMETRY IN COMPTON SCATTERING BY TRANSVERSALLY POLARIZED ELECTRONS. S. C. Miller and R. M. Wilcox (Univ. of Colorado, Boulder). Phys. Rev., 124: 637-9(Nov. 1, 1961).

A left-right asymmetry in the Compton scattering cross section is found for the case when only the target electron is polarized. The incident photon is unpolarized and the polarization of the outgoing photon and electron are assumed not to be measured. This asymmetry results from a radiative correction. It is found that the maximum asymmetry is about one part in a thousand. (auth)

3636 MEASUREMENT OF THE POLARIZATION OF PHOTONEUTRONS FROM DEUTERIUM. Walter John and Frederick V. Martin (Univ. of California, Livermore). Phys. Rev., 124: 830-2(Nov. 1, 1961). (UCRL-6466)

Theoretical studies predict that the neutrons from the reaction D(γ,n)H are polarized. At low gamma energies, the polarization results from an interference between the electric and magnetic dipole transitions. The polarization of the photoneutrons produced from deuterium by the 2.75 Mev gamma rays of Na^{24} is measured. The photoneutrons are scattered from magnesium and the polarization determined from the left-right asymmetry using experimental results for the polarization-analyzing ability of magnesium. For gamma ray-neutron angles (center-of-mass) of 49.6, 71.8, 93.6, 114.8, and 135.7°, the neutron polarizations are found to be -0.34 ± 0.05, -0.23 ± 0.06, -0.22 ± 0.06, -0.29 ± 0.05, and -0.24 ± 0.06, respectively, where positive polarization is taken to be in the direction of $k_\gamma \times k_n$. The results are in agreement with a calculation in the effective-range approximation, assuming only dipole transitions and no noncentral forces. (auth)

3637 ELASTIC SCATTERING OF 11.8-MEV DEUTERONS FROM SEVERAL ELEMENTS. G. Igo, W. Lorenz, and U. Schmidt-Rohr (Max-Planck-Institut für Kernphysik, Heidelberg, Ger.). Phys. Rev., 124: 832-5(Nov. 1, 1961).

The angular distributions of 11.8-Mev deuterons elastically scattered from C, Mg, Al, Ti, Fe, Ni, Cu, Zn, Zr, Nb, Rh, Pd, Ag, Cd, In, Sn, Ta, and Au are measured. The detector is capable of electronically separating deuterons from other ions that may enter the detector. The data are taken in 2-degree steps between 20 and 165°. The structure in the angular distribution observed with the light target elements vanishes with increasing atomic weight. An exception is observed between A = 90 and A = 120. (auth)

3638 POLARIZATION IN 217-MEV p-n AND p-p SCATTERING. John H. Tinlot and Robert E. Warner (Univ. of Rochester, N. Y.). Phys. Rev., 124: 890-6 (Nov. 1, 1961). (NYO-9747)

The polarization in 217-Mev quasi-elastic p-n scattering from deuterium is measured by CD_2-C subtraction. These data cover the angular range 40 to 120° (c.m. system) and are in agreement with the predictions of phase-shift analyses. The polarization in elastic p-p scattering is measured in the angular range 30 to 90° (c.m. system) at an energy of 210 Mev using a liquid hydrogen target, and from 60 to 120° (c.m. system) at 217 Mev using CH_2-C subtraction. These two measurements are in agreement over their common angular range. The data are somewhat better fitted by the

predictions of a boundary-condition model than by phase-shift analyses. The polarization in 217-Mev quasi-elastic p-p scattering from deuterium is measured over the angular range 60 to 110° (c.m. system) by CD_2-C subtraction; these data agree with the elastic p-p polarization results within the statistical precision of the measurements (about 1.5%). (auth)

3639 INFORMATION CONTENT OF PARTICLE TRACKS. Walter H. Barkas (Univ. of California, Berkeley). Phys. Rev., 124: 897-903(Nov. 1, 1961). (UCRL-9578).

The information content of a track is analyzed with respect to the prime track-variable g and to the particle velocity on which g depends. Quantities are operationally defined that are applicable to emulsion, bubble-chamber, or cloud-chamber tracks inclined with arbitrary dip angles. The theory is developed of the projected linear structure of such particle tracks. Connections between the true value of g and measurable track features are reviewed. An independent estimate of g based on the mean blob length is introduced. The two independent quantities, mean gap length and mean blob length, each yield measurements of g. These are combined into an estimate of maximum likelihood. It is argued that in a practical sense this exhausts the information content of the track. The statistical error of this result is evaluated. It is found that correct utilization of the information in the measured blob lengths greatly reduces the error. Suggestions are made regarding technique for the reduction of error in g and in particle masses estimated from grain-density measurements. (auth)

3640 ELASTIC SCATTERING OF PHOTONS BY PROTONS. [PART] I. J. W. DeWire, Martin Feldman, V. L. Highland, and Raphael Littauer (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 124: 909-12(Nov. 1, 1961).

Measurements on the elastic scattering of photons by protons are reported. In the region of the (3,3) resonance and immediately above, these measurements join smoothly with those at lower energies. The scattering cross section shows a peak in the vicinity of 300 Mev. There is indication of a $\cos^2\theta$ term in the center-of-mass angular distribution. (auth)

3641 ELASTIC SCATTERING OF PHOTONS BY PROTONS. [PART] II. A. P. Contogouris (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 124: 912-16(Nov. 1, 1961).

The differential cross section for Compton scattering on protons is calculated at various energies in the region of and above the peak corresponding to the 3-3 pion-nucleon resonance. The unitarity of the S matrix and a set of approximate dispersion relations for the scattering amplitudes are assumed. Small admixtures of electric quadrupole in the radiation that produces the first photopion resonance are shown to affect the angular distribution significantly. In the region of the second photopion peak the resonant behavior is found to be clearly reflected in the proton Compton effect. (auth)

3642 ODD $\Sigma-\Lambda$ PARITY AND PION-HYPERON SCATTERING. Richard H. Capps (Northwestern Univ., Evanston, Ill.). Phys. Rev., 124: 945-6(Nov. 1, 1961).

The static dispersion relations for the S-wave $\pi-\Lambda$ and $\pi-\Sigma$ scattering amplitudes are investigated under the assumptions that the dominant forces result from a scalar $\pi\Lambda\Sigma$ interaction, and that multiple meson processes may be ignored. If it is required that the $\pi-\Lambda$ effective range is small, or alternately, that no subtractions be made in the dispersion relation for the denominator function of the $\pi-\Lambda$ amplitude, the $\pi\Lambda\Sigma$ coupling constant is determined to be $F^2 \sim 1.6$. However, such a strong interaction leads to an attractive force in the isotopic-spin 2, $\pi + \Sigma$ S state that is more than sufficient to produce a bound state. A brief discussion is given of the meaning of this result, and of a possible related mechanism for the 1380-Mev $\pi-\Lambda$ resonance. (auth)

3643 ABSENCE OF $\mu-e$ CONVERSION PROCESSES AND THE $\Delta I = \frac{1}{2}$ RULE. Sidney A. Bludman (Univ. of California, Berkeley). Phys. Rev., 124: 947-52(Nov. 1, 1961). (UCRL-9677)

The lepton and strongly interacting particle currents in the universal Fermi interaction are both assumed to be split into two parts, even and odd, with respect to an internal symmetry operation. The requirement that the over-all interaction be even allows $2\mu \rightarrow 2e$ processes while forbidding single $\mu \rightarrow e$ conversion and requires that the nonleptonic decays come about through the coupling of the strangeness-changing current with itself. This requirement leads to a theory that differs from the schizon scheme by allowing $\Delta S = 2$ leptonic processes, and differs from the veton scheme by associating electrons with muon neutrinos in strangeness-changing processes. (auth)

3644 FORM FACTORS AND VECTOR MESONS. Murray Gell-Mann and Fredrik Zachariasen (California Inst. of Tech., Pasadena). Phys. Rev., 124: 953-64(Nov. 1, 1961). (CTSL-26)

The 2π and 3π resonances are examined from the point of view that they are vector mesons coupled to conserved currents. The theory of unstable mesons is discussed, and formulas are derived for the emission and propagation of these mesons. The connection with electromagnetic form factors is then given, particularly for the simple case of infinite bare mass. The results are similar to those of the dispersion method. Experimental manifestations of universality (connected with the conserved vector current) are discussed. Applications are then made to the decay of π^0 and a group of related phenomena, including several "pole" experiments. Also, the contribution of the 2π resonance to π-N scattering is discussed from the vector meson point of view. Finally, the vector meson approach is compared to the alternative method using dispersion relations applied to presumably dynamical resonances. It is concluded that the dynamical picture is a special case of the vector meson theory with infinite bare mass, a case in which the mass and coupling constant are determined and the behavior at high energies is less singular. The vector meson methods developed are applicable to the dynamical case. (auth)

3645 $K^+ + d$ CHARGE-EXCHANGE REACTION FROM 52 TO 456 Mev. William Slater (Univ. of California, Los Angeles). Donald H. Stork, Harold K. Ticho, Wonyong Lee, William Chinowsky, Gerson Goldhaber, Sulamith Goldhaber, and Thomas O'Halloran. Phys. Rev. Letters, 7: 378-82 (Nov. 15, 1961).

Charge-exchange scattering of K^+ by deuterons was studied in a 15-in. deuterium bubble chamber. The chamber was exposed to a highly separated K^+ beam at 52, 100, 127, 230, 315, and 456 Mev. Events giving a subsequent charged decay made for the K_1^0 were chosen. This sample corresponds to $\frac{2}{3}$ of all K_1^0 decays and thus to $\frac{1}{3}$ of all charge exchange events (both K_1^0 and K_2^0 production). The K^+ path length was obtained by direct measurements on every tenth picture and by inferring the total path length from the number of "τ-like" decays. (L.N.N.)

3646 EVIDENCE FOR A PION-PION RESONANCE FROM PHOTOPRODUCTION OF PION PAIRS. D. McLeod, S. Richert, and A. Silverman (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Letters, 7: 383-5(Nov. 15, 1961).

In the reaction $\gamma + p \rightarrow \pi^+ + \pi^- + p$, it is expected that

the cross section behavior is influenced by interactions between particles in the final state. Measurements of this cross section, designed to give evidence concerning π interactions, were made. Letting $E_{p\pi^+}$, $E_{p\pi^-}$, and $E_{\pi\pi}$ be the total energies of the indicated pairs in the respective center-of-mass systems, the parameters were varied such that $E_{p\pi^+}$ and $E_{p\pi^-}$ were held constant while $E_{\pi\pi}$ was varied. Data were recorded and are represented graphically. Due to the lack of a reliable theory relating resonance parameters to measurements and to the large uncertainty in the maximum $E_{\pi\pi}$, resonance parameters are somewhat uncertain. (L.N.N.)

3647 MEASUREMENT OF THE LINEAR POLARIZATION OF γ RAYS BY THE ELASTIC PHOTOPRODUCTION OF π^0 ON He^4. Nicola Cabibbo (Comitato Nazionale per l'Energia Nucleare, Frascati, Italy and Università, Rome). Phys. Rev. Letters, 7: 386-7 (Nov. 15, 1961).

Measurement requires the observation of azimuthal asymmetries in processes initiated by the rays. The only method well understood is based on pair production. The use of processes involving strongly interacting particles is generally unsatisfactory, but the $\gamma + He^4 \rightarrow \pi^0 + He^4$ seems to be exceptional. The ratio of cross sections at 90° from a beam of linear polarization $\vec{P}$ and parallel to $\vec{P}$ is $(d\sigma_\perp/d\sigma_\parallel) = (1 + |\vec{P}|)/(1 - |\vec{P}|)$. This ratio is 1.5 for 20% polarization and increases very steeply. Statistics are not a problem. (L.N.N.)

3648 PIONIC FORM FACTOR EFFECTS IN PERIPHERAL NUCLEON-NUCLEON COLLISIONS. E. Ferrari and F. Selleri (CERN, Geneva). Phys. Rev. Letters, 7: 387-90 (Nov. 15, 1961).

It is shown that experimental data suggest full dominance of the one-pion-exchange term. A tentative behavior of the pionic form factor is found. Data are presented graphically and in tabular form. (L.N.N.)

3649 SOLUTIONS OF THE PION-PION PARTIAL WAVE DISPERSION RELATIONS. James S. Ball and David Y. Wong (Univ. of California at San Diego, La Jolla). Phys. Rev. Letters, 7: 390-3 (Nov. 15, 1961).

It is shown that a minimum of 3 parameters are required for a realistic solution of the low-energy pion-pion problem. Numerical solutions falling within the uncertainty of present experimental data are presented. The coupled S- and P-wave pion-pion dispersion equations are solved numerically including left-hand cuts satisfying crossing symmetry up to a cutoff point. The remaining left-hand cut of each partial-wave amplitude is replaced by a pole together with a subtraction constant at the symmetry point $\nu = -\frac{3}{2}$, where ν is the center-of-mass momentum squared in pion units. No further reduction in the number of parameters seems possible if only low waves are kept in all absorptive amplitudes. (L.N.N.)

3650 PRINCIPLE OF EQUIVALENCE FOR ALL STRONGLY INTERACTING PARTICLES WITHIN THE S-MATRIX FRAMEWORK. Geoffrey F. Chew and S. C. Frautschi (Univ. of California, Berkeley). Phys. Rev. Letters, 7: 394-7 (Nov. 15, 1961).

The Feynman principle is formulated within the S-matrix framework. It is postulated that all poles of the S-matrix are Regge poles; it is shown how to distinguish between Regge and elementary particle poles. High-energy forward and backward peaks are associated with Regge poles, and together with the principle of maximal analyticity in the J plane, a natural explanation of why low-mass particles tend to have low internal quantum numbers is provided. (L.N.N.)

3651 ANALYTICAL EXPRESSION FOR AN EFFECTIVE MASS OF A PARTICLE MOVING IN ONE-DIMENSIONAL PERIODIC FIELD. P. P. Pavinskii. Vestnik Leningrad. Univ., 16: No. 10, Ser. Fiz. i Khim. No. 2, 8-12 (1961). (In Russian)

A formula for an effective mass of a particle moving in a one-dimensional periodic field is derived. The effective mass is expressed by means of the periodic solution and the second independent solution of the Schrödinger equation for a given end of a zone. As an example, the values of the effective masses corresponding to several first Mathieu functions are given for small values of the parameter. (auth)

3652 POLARIZATION OF Λ HYPERONS PRODUCED BY π^- MESON REACTION WITH LIGHT NUCLEI AT 2.8 BEV. Yu. S. Krestnikov and V. A. Shebanov (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 661-3 (Aug. 1961). (In Russian)

In order to improve statistical data, an analysis was made of over 564 Λ decays recorded in a freon chamber and corresponding to $\pi^- + A \rightarrow \Lambda + K + A' + n\pi$, $\pi^- + A \rightarrow \Sigma^0 + K + A' + n\pi$, and $\Sigma^0 \rightarrow \Lambda + \gamma$ at 2.8 Bev for light nuclei (C, F, and Cl). Among the 564 decays were found 106 events related to the production of $\Lambda + K^0$ and $\Sigma^0 + K^0$. The results are tabulated. (R.V.J.)

3653 ON POSSIBLE ASYMPTOTIC BEHAVIOR IN ELASTIC SCATTERING. V. N. Girbov (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 41: 667-9 (Aug. 1961). (In Russian)

Elastic scattering at high energies has been based on a classical picture of diffraction on a black sphere, where the invariant scattering amplitude A(S,t) is described by $A(S,t) = Sf(t)$. However, the general appearance of this classical picture has never been confirmed. An analysis is made of a different type of asymptotic behavior, with a series of unusual features but theoretically possible, that does not contradict existing data. The development and asymptotic behavior of the two formulas for the imaginary (A_1) and real (D) parts of A(S,t) at $t \sim -1/\xi$: $A_1(S,t) = Cs\, e^{\gamma t \xi}$, and $D(S,t) = Cs(-\gamma t)\, e^{\gamma t \xi}$ are analyzed. (R.V.J.)

3654 RASPROSTRANENIE ELEKTROMAGNITNYKH VOLN V PLAZME. (Propagation of Electromagnetic Waves in Plasma). V. L. Ginzburg. Moscow, Fizmatgiz, 1960. 552p.

The propagation of electromagnetic waves of various frequencies in isotropic and in magnetically active plasma is discussed. Special attention is given to propagation of radiowaves in the ionosphere and in cosmic space. Nonlinear effects found in an alternating electromagnetic field are also considered. 349 references. (R.V.J.)

Neutron Physics

3655 (AD-257584) NEUTRON DENSITY DISTRIBUTION IN AN UNREFLECTED SUBCRITICAL REACTOR CORE (thesis). Thomas T. Doss (Texas. Univ., Austin). June 1961. 70p.

The four models used to study neutron distribution are discussed. The thermal neutron distribution within the bare core of a subcritical reactor was measured using indium foils as activation detectors. Neutron density determinations were made in both the radial and axial directions with a constant source of 3.36×10^6 fast neutrons per second located at the center of the core. Those distributions were then fitted to those predicted by one-group

theory for comparison. Both the axial and radial distributions were determined. (M.C.G.)

3656 (GA-2503) DIFFERENTIAL NEUTRON THERMALIZATION. Annual Summary Report, October 1, 1960 through September 30, 1961. W. L. Whittemore and A. W. McReynolds (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Oct. 20, 1961. Contract AT(04-3)-167. 94p.

Activities in a program of studies on the interaction mechanisms by which neutrons exchange energy with H atoms are reported. Above about 1 ev these may be regarded as collisions of neutrons with free H atoms, but at lower energies they must be regarded in terms of excitations causing molecular thermal motions determined by binding forces. Neutron thermalization is concerned with the distribution of energy levels and the probability of excitation by neutron collision. Particular emphasis was placed on studies of scattering in very low temperature materials where binding effects are most apparent, and of low energy neutron scattering. Experiments in these areas of interest were carried out with neutrons from a pulsed linear accelerator. Energy distributions in various moderating materials at 295 to 4°K were studied by time-of-flight analysis. Included are discussions of experimental techniques, experimental data, and conclusions concerning the dynamic behavior of various hydrogenous substances. (J.R.D.)

3657 (NARF-61-33T) A MONTE CARLO PROCEDURE FOR CALCULATING PENETRATION OF NEUTRONS THROUGH STRAIGHT CYLINDRICAL DUCTS. D. G. Collins (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Nov. 24, 1961. Contract AF33(657)-7201. 50p. (MR-N-286)

The Monte Carlo method is applied to evaluate the energy and angular distributions and the intensity of the scattered neutron flux that penetrates a straight cylindrical duct. A discussion of the scattering theory involved is given, as well as the sampling techniques peculiar to the duct-penetration problem. The method is evaluated on the basis of comparisons with experimental data. (auth)

3658 (NP-11106) MEDICION DEL ALCANCE DE LOS NEUTRONES CON UNA FUENTE DE Po–α–Be EN AGUA. INFORME NO. 43. (Measurement of the Range of Neutrons with a Po–α–Be Source in Water. Report No. 43). Maria Delfina Bovisio de Ricabarra and Guillermo H. Ricabarra (Argentina. Comision Nacional de Energia Atomica, Buenos Aires). 1961. 15p.

Considerations are given for the use of the foil method for determining the values of the nuclear parameters of interest in reactor design: the migration area, M^2; and the Fermi age, $\tau_{(1.4ev)}$. The results: $M^2 = 67.2 \pm 1.3$ cm^2, and $\tau_{(1.4ev)} = 55.6 \pm 1.1$ cm^2, agree very well within the experimental statistical error with previous studies. Corrections are included for the activities of the foils for a finite size of the source and the detectors, and for the activity in the foils influenced by very high energy neutrons. (B.O.G.)

3659 PROMPT NEUTRON LIFE TIME IN REFLECTED THERMAL REACTOR. Hideo Kuroi (Japan Atomic Energy Research Inst., Tokyo). J. At. Energ. Soc. Japan, 3: 691-7(Sept. 1961). (In Japanese)

A method is developed for calculating prompt neutron lifetimes in a thermal reactor with a reflector. Neutron life in a D_2O moderated spherical reactor with a D_2O reflector is calculated. Reflector materials must have low thermal neutron absorption cross section, in comparison with core materials, so that resident time of neutron in reflector is usually longer. Therefore, prompt neutron lifetime is expected to be strongly affected by neutrons which are produced by fission in core, spend time in reflector, and are absorbed in core. To evaluate contributions of such neutrons to prompt neutron lifetime, the two group albedo theory is used. (auth)

3660 NEUTRON SPECTRUM TEMPERATURE DISTRIBUTION IN HETEROGENEOUS MEDIA WITH ENERGY DEPENDENT ABSORPTION. Zbigniew Weiss (Inst. of Nuclear Research, Warsaw). Nukleonika, 6: 443-60(1961). (In English)

The problem of neutron thermalization in heavy gas was solved in P_1 approximation by means of the expansion in Laguerre polynomials. The absorption cross section was assumed to be energy-dependent. More detailed calculations were performed for 1/v absorption. A system of coupled equations was obtained for the energy moments of the spectrum. The number of equations is N + 1, where N is a subscript of the last–retained Laguerre polynomial. The formulated boundary conditions allow solution of the equations for heterogeneous media. Finally, the L_1 approximation was compared with a "physical" approximation, based on the neglecting of epithermal absorption. The L_1 approximation was found to correspond to the system of equations obtained from linearization of the nonlinear equations resulting from the "physical" approximation. (auth)

3661 INELASTIC SCATTERING OF SLOW NEUTRONS FROM METHANE. P. D. Randolph, R. M. Brugger, K. A. Strong, and R. E. Schmunk (Phillips Petroleum Co., Idaho Falls, Idaho). Phys. Rev., 124: 460-9(Oct. 15, 1961).

Partial differential cross sections for the scattering of neutrons of 0.0150, 0.0252, 0.0706, 0.103, and 0.142 ev initial energy into angles of 16.3°, 26.0°, 36.4°, 47.6°, 59.5°, 72.1°, and 84.7° from samples of room temperature methane gas are presented. These are converted to scattering law and are compared to three calculations: the ideal gas calculation gives limited agreement using a mass of 3.2, the average of the Sachs-Teller mass tensor; the Krieger-Nelkin approximation which includes effects of zero-point vibrations is a better fit, but underestimates in the region of large momentum transfers; a calculation using exact thermal orientation averages of the matrix elements gives the best fits. None explain the results at small energy and momentum changes; this disagreement is attributed to the classical treatment of the rotational states in these calculations. (auth)

3662 NEUTRON SCATTERING BY THE COMPLEX HARMONIC OSCILLATOR POTENTIAL. J. Sokoloff (Argonne National Lab., Ill. and Northwestern Univ., Evanston, Ill.). Phys. Rev., 124: 826-9(Nov. 1, 1961).

A complex harmonic oscillator potential is used in an attempt to fit low-energy neutron scattering and absorption data. Differential scattering cross sections are compared with experiment for 1-Mev incident neutrons and a wide spectrum of target nuclei. Total cross sections are compared with experiment at 350 kev, 1 Mev, and 1440 kev for an extensive mass spectrum. For the parameters used in the calculations, the complex harmonic oscillator seems to share the shortcomings of the "best-fit" complex square well. (auth)

3663 NEUTRON GAS. J. S. Levinger and L. M. Simmons (Louisiana State Univ., Baton Rouge). Phys. Rev., 124: 916-22(Nov. 1, 1961).

The neutron-neutron potential is assumed to be well-behaved and velocity-dependent. Perturbation theory is

then applied to find the energy per particle of a neutron gas, in the range of Fermi wave numbers $0.5 < k_f < 2\ f^{-1}$. The energy through first order is found in closed form, or by a single numerical integration. Two different velocity-dependent potentials are used that are adjusted to fit observed nucleon-nucleon ^1S and ^1D phase shifts. In the range of densities $0.5 < k_f < 1\ f^{-1}$, these two potentials give nearly the same energy/particle (within 0.5 Mev). Wider divergences appear at higher densities. A crude estimate of the second-order energy for these potentials indicates that perturbation theory converges rapidly in the density range considered. The results suggest that at moderately low densities the energy/particle in a many-body system is insensitive to the shape or nonlocal character of the assumed two-body potential. (auth)

Nuclear Properties and Reactions

Refer also to abstract 3867

3664 (AFOSR-856) AN EXAMPLE OF Σ^- CAPTURE WITH EMISSION OF A NEGATIVE PION. Scientific Note No. 1. G. Kellner, G. Czapek, and B. Czapp (Vienna. Universität. Institut für Theoretische Physik). Mar. 29, 1961. Contract [AF]61(052)-433. 10p. (AD-258082)

An event is described which consists in a slow singly charged particle of super-protonic mass interacting in flight with an emulsion nucleus producing a star with four visible prongs, one of them being a negative π meson. The event is consistent with the assumption that a negative hyperon captured by a nucleus interacts according to $\Sigma^- + p \rightarrow \Lambda^0 + n$, the Λ^0 being trapped in the target nucleus giving rise to mesonic breakup of the excited nucleus. (auth)

3665 (BRL-TN-1394) A METHOD FOR RECORDING NUCLEAR RESONANCE CAPTURE SPECTRA. Thomas R. Jeter and John D. Baldeschwieler (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Mar. 1961. 12p. (AD-258018)

A method is described for continuously varying the Van de Graaff ion beam energy while the count rate from the decay of the compound nucleus is monitored and recorded. The method utilizes a synchronous motor system to synchronize the recorder and the magnetic field control of the Van de Graaff analyzing system. Use of this method results in significant time saving in calibration of the Van de Graaff accelerator and the determination of target thicknesses. (auth)

3666 (EANDC(E)-21) NUCLEAR DATA NEEDS FOR FAST AND INTERMEDIATE REACTOR CALCULATIONS. J. J. Schmidt (Kernforschungszentrum, Karlsruhe, Germany). June 14, 1961. 27p.

Revised edition of EANDC-(E)-9L.

Tables are presented outlining the nuclear cross section requirements for fast and intermediate reactors with comments on gaps and inconsistencies. Some of the main nuclear data requirements are discussed: inelastic neutron scattering, neutron absorption, resonances, and parameters. A bibliography of 89 references is included. (D.L.C.)

3667 (GA-2438) THE CALCULATION OF THERMAL-NEUTRON SCATTERING KERNELS IN GRAPHITE. D. E. Parks (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Oct. 10, 1961. Contract AT(04-3)-314. 26p.

Approximate methods were developed for computing the differential energy-transfer cross section for polycrystalline graphite, within the framework of the incoherent approximation. The approximations are also valid for the case of scattering by isotropic crystals. (D.L.C.)

3668 (NYO-7864) REACTION STUDIES WITH FAST NEUTRONS. R. A. Peck, Jr. and D. R. Maxson (Brown Univ., Providence). Nov. 1, 1961. Contract AT(30-1)-1082. 32p.

The accelerator voltage is being doubled by installation of a commercial 350 kv supply. Resolution studies of (n,d) on N^{14}, P^{31}, S^{32}, and (p,α) on Li^7, Be^9, C^{12}, and O; and, polarization in elastic neutron scattering from C, Mg, Al, Ni, and Cu are reported. An experimental study of electron trajectories in a dipole magnetic field has given results discouraging as to the feasibility of this approach to separation of polarization states. Work in progress or preparation deals with: search for level in He^6 via $Li^7(d,\alpha)\alpha + n$ coincidence spectroscopy; (n,α) studies with counters; (n,d) and (n,p) on I^{127} (counters), S^{32} and V^{51} (plates). (auth)

3669 (TID-13075) THE PULSE DISTRIBUTIONS IN STILBENE PRODUCED BY 1-15 MEV NEUTRONS, CORRECTED FOR END EFFECT. Allen Brodsky (Division of Licensing and Regulation, AEC). June 1961. 68p.

Derivations and calculations of the pulse amplitude distribution in an hydrogenous phosphor (stilbene) that emits light pulses when protons of the phosphor are recoiled by incident 1 to 15 Mev neutrons are presented. The purpose of the calculations was to obtain an accurate account of the corrections necessary for recoiling protons that escape the back surface of the phosphor before losing all of their energy. These corrections are referred to as "end-effect" corrections. Pulse amplitude distributions corrected for the end effect were calculated and compared with those given by the approximations of Swartz, Owen, and Ames. The approximation of Swartz, Owen, and Ames was found to give a pulse distribution from escaping protons that is accurate to within 10% over the energy range 2 to 15 Mev. The integrals of the more exact distributions agree with the detection efficiencies calculated from cross-section data to within 1 to 2%. This indicates that the approximation method is sufficiently accurate for most purposes of neutron spectroscopy. Empirical range-energy and pulse-height-energy equations are also presented. (auth)

3670 (TID-13666) TABLES FOR THE ANALYSIS OF β-γ ANGULAR CORRELATION DATA INVOLVING FIRST-FORBIDDEN β-TRANSITIONS IN A 3^- (β) $\rightarrow 2^+$ (γ) $\rightarrow 0^+$ CASCADE. P. Alexander and R. M. Steffen (Purdue Univ., Lafayette, Ind.). Aug. 1961. Contract AT(11-1)-123. 380p.

3671 (TID-14241) STUDIES OF LOW-ENERGY NUCLEAR REACTIONS IN MEDIUM MASS NUCLEI—DECAY SCHEME STUDIES. Technical Progress Report, November 15, 1960 to November 14, 1961. Brian D. Pate (Washington Univ., St. Louis). Contract AT(11-1)-870. 20p.

Nuclear Reactions. Natural Mo foil targets were bombarded with α particles at energies up to 40 Mev, and excitation functions were determined for the following reactions: Mo^{92}(α,n), (α,p), (α,αn), (α,α2n), (α,pn), (α,p2n) + (α,3n); and Mo^{100}(α,n). The performance of a diffused junction Si counter with 20-Mev α particles scattered from C is presented, and development of other solid-state counters is discussed. Decay Scheme Studies. Work on techniques for decay studies is described briefly. Gamma spectra are presented for natural Sn and Sn^{112} bombarded with 20-Mev α particles which confirm the assignment of the 6-min period to Te^{115} and the 30-min period to

Sb^{115}. A Kurie plot of the 6-min β^+ spectrum of Sn bombarded with α particles is also presented. The total NaI gamma spectra associated with the Ag isotopes separated from deuteron-induced fission products of U^{238} are given with resolutions, and some γ-γ coincidence measurements are given. Observations of activities found in Mo bombarded with 20-Mev α particles are reported. (D.L.C.)

3672 (USNRDL-TR-528) EARLY TIME DECAY OF FISSION PRODUCT MIXTURES. IV. GAMMA IONIZATION CHAMBER MEASUREMENTS FOLLOWING THERMAL NEUTRON FISSION OF Pu^{239}. P. O. Strom, D. Sam, J. Mackin, and P. Zigman (Naval Radiological Defense Lab., San Francisco). Sept. 15, 1961. 21p.

Gamma ionization chamber readings are given for the products of thermal neutron fission of Pu^{239} for the period from 1 second to about 22 hours following fission. Using spectral data on U^{235} fission products and ionization chamber efficiency with gamma energy, the energy release rate of Pu^{239} fission products was determined as a function of time. The results were compared with those attained for U^{235} fission products. (auth)

3673 (WASH-1033) REPORTS TO THE AEC NUCLEAR CROSS SECTIONS ADVISORY GROUP MIT AND YALE, AUGUST 29-31, 1961. John R. Stehn (Nuclear Cross Sections Advisory Group, AEC). 51p.

The reports contain informal statements of recent developments, changes of emphasis, and preliminary data which are of importance to the AEC cross section measurement program. The reports are arranged according to the originating company or agency. (D.L.C.)

3674 (CEA-tr-R-1371) MASSES ISOTOPIQUES ET ÉNERGIE DE LIAISON DE NOYAUX À NOMBRE ATOMIQUE COMPRIS ENTRE 186 ET 196. (Isotopic Masses and Binding Energies of Nuclei of Atomic Number Between 186 and 196). R. A. Demirkhanov, T. I. Gutkin, and V. V. Dorokhov. Translated into French by B. Vinogradoff from Zhur. Eksptl'. i Teoret. Fiz., 37: 1218-24(1959). 23p.

The isotopic mass values and binding energies of isotopes of osmium, iridium, platinum, gold, and mercury are given. The mass measurements were made with the aid of a mass spectrograph with a resolution power of 60,000 to 80,000. The isotopic masses were determined from spectral doublets by direct comparison with the masses of corresponding organic compounds. The masses of 18 stable isotopes were measured and the masses of 18 radioactive isotopes were calculated. The data obtained were used for the calculation of the binding energy of nuclei, of the binding energy per nucleon (E/A), of the binding energy of the last neutron and proton (B_n and B_p) and of the energy of neutron pairs and P_n and P_p protons. The non-monotonous shape of the binding energy for N = 116 was noted. This character is preserved both for the even values of Z, as well as for odd values. (tr-auth)

3675 (JPRS-8937(p.1-9)) WAVE FUNCTIONS AND POLARIZATION STATES OF A TWO-PHOTON SYSTEM. Wang Yung. Translated from Wu Li Hsüeh Pao, 15: No. 2, 55-62(Feb. 1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract no. 15540.

3676 ON THE RELATIONS BETWEEN HALF-LIFE AND ENERGY RELEASE IN ALPHA DECAY. R. Taagepera and M. Nurmia (Univ. of Helsinki). Ann. Acad. Sci. Fennicae, Ser. A. VI, No. 78: 1-16(1961). (In English)

By introducing approximations in the Bethe equation, the following expression for the logarithm of the half life of an alpha-active nuclide is obtained: $\log T = C_1X - C_2$, where $X = Z_d E^{-1/2} - Z_d^{2/3}$, Z_d being the atomic number of the daughter and E the alpha-particle energy. By choosing $C_1 = 1.61$, $C_2 = 28.9$, a good fit for most alpha emitters is obtained. The formula also predicts half lives of the right order of magnitude for such alpha emitters as He^6 and Li^6. The effects of closed shells, spin change, and odd nucleons are investigated, and examples of the application of the formula are discussed. (auth)

3677 L AUGER ELECTRON SPECTRUM OF THALLIUM IN THE ELECTRON CAPTURE DECAY OF Pb^{203}. Ziemowid Sujkowski and Olle Melin (Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 20: 193-207(1961). (In English)

The L Auger electron spectrum of Tl was measured in a double-focusing beta-ray spectrometer using an isotope-separated Pb^{203} sample. Twenty-nine lines or line groups were resolved and interpreted in the energy region between 5 and 15 kev and their relative intensities were determined. Assuming the fluorescence yield for the L_{III} shell to be 0.32 and the sum of Coster-Kronig yields for the L_I shell to be 0.73, the remaining Auger, fluorescence and Coster-Kronig yields for the L subshells of Tl were $\alpha_{L_I} = 0.16 \pm 0.06$, $\alpha_{L_{II}} = 0.43 \pm 0.12$, $\alpha_{L_{III}} = 0.68$, $\omega_{L_I} = 0.11 \pm 0.025$, $\omega_{L_{II}} = 0.32 \pm 0.05$, $f_{L_IL_{II}} = 0.17 \pm 0.05$, $f_{L_IL_{III}} = 0.56 \pm 0.07$, $f_{L_{II}L_{III}} = 0.25 \pm 0.13$. (auth)

3678 GAMMA TRANSITION PROBABILITIES AND THE AUGER EFFECT IN THE β-DECAY OF Xe^{133}. Peter Erman and Ziemowid Sujkowski (Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 20: 209-42(1961). (In English)

Decay of Xe^{133} is studied in detail using scintillation and β-spectrometric techniques. The 81.0, 160.5, 302, and 382 kev γ transitions in Cs^{133} are detected in the γ spectrum and their intensity ratios determined to be 1, 1.09×10^{-3}, 1.23×10^{-4}, and 6.2×10^{-6}. In addition the 79.6-kev transition from the second excited level of Cs^{133} is observed in the internal conversion spectrum, as well as in the γ-coincidence spectrum, and the total branching ratio to this level is determined. The $K/L_I/L_{II}/L_{III}/M/N$ conversion ratios of the 81.0-kev transition are determined. The K conversion coefficient of this transition is remeasured and found to be 1.39 ± 0.06. The half life of Xe^{133m} is determined to be 54.24 ± 0.40 hours. The decay scheme of Xe^{133} is discussed. Nuclear structure effects on the conversion of the M1 l-forbidden 81-kev transition are considered according to the theory of Church and Weneser. The KLL, KLX and KXY Auger spectra of Cs are studied and the results are compared to the theory of Asaad and Burhop. A brief discussion of the post-acceleration technique used for the detection of low energy electrons is given in an appendix in connection with the measured L Auger spectrum. (auth)

3679 BETA SPECTROMETRIC STUDY ON THE DECAY OF Pb^{203} AND K AUGER SPECTRUM OF Tl. Ziemowid Sujkowski (Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 20: 243-67(1961). (In English)

Internal and external conversion spectra from the decay of Pb^{203} were studied in a double-focusing β spectrometer. The internal conversion coefficients of the 279- and 401-kev transitions were determined by comparing the intensities of the internal conversion- and the photo-lines and calculating the correction factors for the anisotropy of the photoelectric emission according to the method of Hultberg. The accuracy of the method is discussed. The directional correlation $\gamma - e_k^-$ for the 401- to 279-kev cascade was measured in the double-focusing β spectrometer. The results are discussed in connection with the nuclear structure effects on the internal conversion process, which are expected to show up in the retarded 279-kev transition (M1, l-forbidden). In the second part of this study the K – LL, –LM, –LN, –MM, –MN, and NN Auger spectra of Tl were measured using an isotope separated Pb^{203} sample. The relative

intensities of the lines or line groups were determined and the results were compared with the theory of Asaad and Burhop (non-relativistic) and of Asaad (relativistic). (auth)

3680 DETERMINATION OF THE RELATIVE INTENSITIES OF THE GAMMA RAYS FROM THE DECAY OF Ta^{182} BY THE EXTERNAL CONVERSION METHOD. Hans Ryde and Ziemowid Sujkowski (Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 20: 289-321(1961). (In English)

A study of the relative intensities of the gamma rays from the decay of Ta^{182} to W^{182} was performed using the external conversion method. Photo-electrons from uranium converters are analyzed in a double-focusing beta ray spectrometer. To obtain relative gamma ray intensities, corrections for angular dependence of the photo-electric process are applied according to the method of Hultberg. Corrections for self-absorption in the source are considered and their importance in the low energy region is emphasized. Special experiments with three sources of different thicknesses are carried out in order to obtain an experimental check for calculated corrections for self-absorption. K conversion coefficients are calculated using relative intensities of the internal conversion lines from other work. The experimentally obtained data are compared with predictions of the unified nuclear model as well as the Davydov-Filippov theory for non-axially symmetric, even nuclei. (auth)

3681 INCOHERENT SCATTERING OF 662 KEV GAMMA RAYS ON THE K ELECTRONS OF LEAD. Ziemowid Sujkowski and Bengt Nagel (Nobel Inst. of Physics, Stockholm and Royal Inst. of Tech., Stockholm). Arkiv Fysik, 20: 323-40(1961). (In English)

Large deviations from the Klein-Nishina differential cross-sections for inelastic scattering of gamma rays on electrons can be expected when the scattering electrons are strongly bound in the inner electron shells in heavy elements. Photons at 662 kev from Cs^{137} were scattered on a thin lead target. Selection of inelastic scattering events on the K electrons in the target was attained by observing the scattered photons in coincidence with the K x-rays from lead. The cross sections per steradian were determined for the effect at three angles $\theta = 28°$, 68°, and 132.5°, and were found to be 0.29, 0.87, and 1.0 of the corresponding Klein-Nishina cross-sections, respectively. The coincidence gamma spectrum was displayed on a 100-channel pulse-height analyzer. Distributions of the scattered photons were found to be broader than those for the scattering on free electrons. No defect in the Compton shift was observed at large angles, in contrast to early reports on scattering of low energy photons on light elements. In addition, the distribution of the photons scattered through 28° was found to be peaked at an energy about 48 kev smaller than that expected for free-electron scattering. An approximate treatment of the process is given in terms of the incoherent scattering function S, calculated for the K electrons. (auth)

3682 ON THE CHANGE OF THE SINGLE-PARTICLE ENERGIES DUE TO A VARIATION OF THE PAIR DISTRIBUTION IN NUCLEI OF TYPE SINGLE CLOSED SHELL ± 1. Lars Silverberg (NORDITA, Copenhagen and Inst. for Theoretical Physics, Lund, Sweden). Arkiv Fysik, 20: 341-53(1961). (In English)

A calculation is performed for nuclei where one of the nucleon numbers differs by only one unit from the magic number 50 or 82. The core is described by a pairing and P^2 Hamiltonian, and the neutron-proton force is treated as a P^2 + short-range force. The P^2 part is treated as vibrations, the short-range part in first-order perturbation theory. The energy shifts between different levels in various nuclei are calculated and compared with experimental data. (auth)

3683 NUCLEAR MODEL CALCULATIONS ON Tl^{205}. Lars Silverberg (NORDITA, Copenhagen and Inst. for Theoretical Physics, Lund, Sweden). Arkiv Fysik, 20: 355-81 (1961). (In English)

A shell-model calculation is performed with the nucleus considered as three holes moving in a static potential and interacting with each other by some residual force. The central two-body force is treated for conventional values of the entering parameters. The influence of a hard core and a tensor force, treated by means of an extremely simplified model, is discussed. Further, the same nucleus is calculated as one proton hole coupled to a vibrating core. Nuclear properties are calculated (B-values for γ-transitions, magnetic moments), and the results of the two calculations are compared with each other and with experimental data. (auth)

3684 ELASTIC SCATTERING OF 15-MEV NEUTRONS BY COPPER, LEAD AND U^{238} NUCLEI. B. Ya. Guzhovskii. Atomnaya Energ., 11: 395-6(Oct. 1961). (In Russian)

The differential cross sections of elastically scattered 15 ± 0.4 Mev neutrons by spheric Cu and Pb and strongly deformed U^{238} nuclei were compared with theoretical values obtained on the basis of the optical model of the nucleus. The neutron flux was generated by bombarding a thick Zr–T target with deuterons accelerated electrostatically to 290 kev; the scatterers consisted of thin-walled cylinders or rings. Plastic and stilbene scintillators were used as detectors, in connection with a 50-channel amplitude analyzer. The values obtained for Cu and Pb agree well with previously published data; similar agreement was obtained for U^{238} and known values of natural U in the angular region of 10 to 55°. The experimental results also agree well with the theoretical calculations. The divergence due to the non-spheric character of the U^{238} nucleus can be determined only after the necessary corrections will have been made for angular resolution, attenuation and multiple scattering. This divergence is expected to be noticeable only in the region of the first minimum. (TTT)

3685 MEASUREMENT OF THE INELASTIC INTERACTION CROSS SECTION OF 13 TO 20 MEV NEUTRONS FOR CERTAIN ISOTOPES. Yu. G. Degtyarev and V. G. Nadtochii. Atomnaya Energ., 11: 397-8(Oct. 1961). (In Russian)

The inelastic scattering cross section of U^{235} and Pu^{239} for neutron energies ranging from 13 to 20 Mev were determined to fill the gap in the literature; in addition, similar measurements were carried out for U^{238}, Al, Fe, Cu and Pb for the purpose of checking previously obtained data. The experimental device consisted of an external neutron source and a detector placed within the sphere made of the material under study. This arrangement made it possible to use anisotropic sources, thus broadening the available energy range. The neutrons were produced on a Van de Graaff generator by the $T(n,d)He^4$ reaction; the neutron spectrum obtained after scattering was analyzed on a 20-channel amplitude analyzer. The inelastic scattering cross section of U^{235} ranged from 2.64 ± 0.06 millibarn for 13.4 Mev to 2.74 ± 0.07 millibarn for 18.7 Mev neutrons; the corresponding value for Pu^{239} at 16.8 Mev was found to be 2.87 ± 0.1 millibarn. The values of the other elements investigated agree well with previously published data. (TTT)

3686 INELASTIC SCATTERING OF 14-MEV NEUTRONS BY SODIUM, IRON, NICKEL AND LEAD NUCLEI. B. I. Sukhanov and V. G. Rukavishnikov. Atomnaya Energ., 11: 398-9(Oct. 1961). (In Russian)

Making use of the time-of-flight method, the inelastic scattering spectra of neutrons in the energy range of 0.6 to 4.0 Mev were determined by bombarding natural isotopic mixtures of Na, Fe, Ni and Pb with 14-Mev neutrons. The experimental arrangement consisted of a pulsed source, neutron detectors and the apparatus needed for time-of-flight measurements. The source was operated at a frequency of 500 hertz with $2.5 \cdot 10^{-6}$ sec neutron pulses and a flight distance of 6 m; a liquid xylene scintillator was used as detector. The spectra were analyzed on a 128-channel amplitude analyzer. The temperature, T, of the residual nucleus, calculated from the relationship $(dN/dE) \sim Ee^{-E/T}$, gave the following results: Na, 0.97 ± 0.09; Fe, 0.80 ± 0.08; Ni, 0.79 ± 0.08; Pb, 0.75 ± 0.08 Mev. The data for Fe and Pb agree quite well with available literature data. (TTT)

3687 THE LONG-LIFE ISOTOPE Al^{26} IN THE STRUCTURAL ALUMINUM USED IN NUCLEAR REACTORS. S. S. Vasil'ev, T. N. Mikhaleva, N. P. Rudenko, A. I. Savast'yanov, and V. S. Zazulin. Atomnaya Energ., 11: 401-3(Oct. 1961). (In Russian)

Of the Al isotopes only Al^{26} with a half-life of $(7.83 \pm 0.29) \cdot 10^5$ years can be used as a tracer. The isotope may be prepared by a (n,2n) reaction during the irradiation of Al^{27} by fast neutrons in a reactor; however, the yield is very low. It was assumed that structural Al used in a reactor in a position close to the core might contain larger amounts of Al^{26} and therefore such a "spent" material was used for determining the isotopic concentration. The sample was purified, removing all the surface contamination resulting from fission products and its Al^{26} content was determined on the basis of the E_γ = 1.83 Mev line of the γ spectrum. It was found that the sample contained Al^{26} in amounts reaching $2.5 \cdot 10^4$ disintegration per minute which exceeds by 3 orders of magnitude the previous yield from Al samples irradiated for 1 year in a reactor. (TTT)

3688 RADIOISOTOPES FROM SMALL REACTORS. G. Hauck (Gutehoffnungshütte Sterkrade AG, Oberhausen, Ger.). Atomwirtschaft, 6: 485-8(Oct. 1961). (In German)

Short-lived radioisotopes are particularly advantageous for numerous applications since they make possible the use of relatively high activities without long term contamination of the material involved. Their short life, however, requires their production in the immediate neighbourhood of the place where they are to be used. Various types of small research reactors are especially suitable for this purpose. The possibilities are discussed for the production of more than a hundred radionucleides with half lives between 5 minutes and 100 days using a neutron flux of 7×10^{11} n/cm²/sec. (auth)

3689 GAMMA RAYS FROM THE $^{27}Al(p,\gamma)$ REACTION. S. Bashkin and T R. Ophel (Australian National Univ., Canberra). Australian J. Phys., 14: 335-46(Sept. 1961).

Gamma-ray spectra and angular distributions are measured at the 759, 766, 773, and 993 kev resonances of the $Al^{27}(p,\gamma)$ reaction. The results obtained at the lower resonance are in agreement with previous work. At the 993 kev resonance a transition to the 7.80 Mev level of Si^{28} is observed. Tentative J^π assignments to the resonance levels of 2^-(759 kev), 4^-(766 kev), 1^+(773 kev), and 3^+(993 kev) are discussed. (auth)

3690 INELASTIC SCATTERING OF PROTONS ON C^{12}. V. R. McKenna and G. G. Shute (Univ. of Melbourne). Australian J. Phys., 14: 432-5(Sept. 1961).

Angular distributions for this inelastic process are determined at approximately 5° intervals, between 170 and 25° scattering angles, over the energy range $11\frac{1}{2}$ to 8 Mev. From the angular distributions the behavior of the cross section at fixed scattering angles for differing incident energies is obtained. In order to show resonance structure, excitation functions are graphically shown for scattering angles of 65, 85.3, 137.6, and 168°. Resonances are clearly indicated at 7.6, 8.2, 9.2, 10.3, 10.5, and 11.0 Mev. (N.W.R.)

3691 THE $B^{10}(\alpha,n)N^{13}$ AND $B^{10}(t,2n)C^{11}$ REACTION IN A NUCLEAR REACTOR. J. C. Roy and J. J. Hawton (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 39: 1528-34(Nov. 1961). (AECL-1336)

Ten-minute N^{13} and 20-minute C^{11} were produced in the NRX reactor by the reactions $B^{10}(\alpha,n)N^{13}$ and $B^{10}(t,2n)C^{11}$. The alpha particles and the tritons were generated by thermal neutron capture in B^{10} and Li^6, respectively. These reactions offer a simple and rapid method of obtaining C^{11} and N^{13} in fairly high specific activities. It is estimated that activities of the order of 100 μc of N^{13} and 1 mc of C^{11} can be produced in a thermal neutron flux of 6.5×10^{13} n/cm² sec. Incidental to these studies are some observations on the chemical behavior of N^{13} and C^{11} recoil atoms in a few boron compounds. (auth)

3692 HIGHER-ENERGY GAMMA RAYS IN THE DECAY OF NEPTUNIUM-239. R. D. Connor and D. R. MacKenzie (Univ. of Manitoba, Winnipeg). Can. J. Phys., 39: 1595-9(Nov. 1961). (AECL-1361)

In the decay of neptunium-239 only two γ rays with energies in excess of 335 kev are detected. These have energies of 440 ± 10 and 490 ± 10 kev and intensities of $3.6 \pm 0.9 \times 10^{-5}$ and $2.0 \pm 0.5 \times 10^{-5}$ photons per disintegration, respectively. A search at high resolution failed to reveal the associated conversion lines in the β spectrum. (auth)

3693 THE ANISOTROPY OF THE MOSSBAUER EFFECT. Yu. Kagan. Doklady Akad. Nauk S.S.S.R., 140: 794-6(Oct. 1, 1961). (In Russian)

The probability of resonance absorption (or emission) of γ quanta in non-cubic crystals should show an anisotropic effect, since the probability of phonon excitation depends on the direction of the recoil momentum of the nucleus with respect to the crystal axes. A simple rhombic lattice is considered in which the atoms interact centrally and non-centrally with neighboring atoms (along the edges of a parallelopiped). The anisotropy of the Mossbauer effect is estimated by comparing values of the tensor $T^{\xi\xi}$ for various crystal axes by taking into consideration the actual parameters of the crystal. White tin which has a tetragonal symmetry (a ≈ 5.8 Å, c ≈ 3.15 Å) possesses a single-atom, non-cubic, crystal lattice which shows the Mossbauer effect. Values of the lattice constants c_{ik} were measured at two temperatures: T = 93°K and T = 288°K. Calculations of the tensors T_{11} to T_{33}, which characterizes the anisotropy, was found to be about 1.17. Thus, the intensity of recoilless emission along the c axis is greater than that in a perpendicular direction. In determining the anisotropy of the direct Mossbauer effect, the absolute value of the tensor $T^{\xi\xi}$ is estimated from the derived equations by using a Debye temperature $\theta \approx 200$°K and a recoil energy of $R = E_\gamma^2/2\,mc^2$ (E_γ = 23.8 kev). It is found that the ratio of probabilities at T = 0°K is $\omega_3/\omega_1 = 1.04$. Direct calculations showed that the anisotropy effect varies only slightly with increasing temperature. (TTT)

3694 RADIATIONS FROM 83 MIN ^{139}Ba. J. T. Wasson and C. D. Coryell (Massachusetts Inst. of Tech., Cambridge). J. Inorg. & Nuclear Chem., 20: 1-5(Nov. 1961). (In English)

The decay scheme of 83 min Ba^{139} was examined by detailed γ-scintillation spectroscopy. The energies of the γ rays in Mev and their relative intensities are 0.165 (100),

1.092 ± 0.015 (0.12), 1.272 ± 0.012 (0.30), and 1.433 ± 0.008 (1.8). No evidence was found for the γ ray of 0.78 Mev which was previously reported. Results are incorporated in a decay scheme, in which the absolute yield of the 0.165 Mev level was used to calculate the β-group intensities. (auth)

3695 THE INDEPENDENT YIELD OF ^{136}Cs IN THE THERMAL NEUTRON FISSION OF ^{235}U, ^{233}U AND ^{239}Pu. W. E. Grummitt and G. M. Milton (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Inorg. & Nuclear Chem., 20: 6-11(Nov. 1961). (In English)

A remeasurement of the independent yield of Cs^{136} in the thermal fission of U^{235}, U^{233}, and Pu^{239} established the values of 6.85×10^{-3}, 0.118, and 8.35×10^{-2}%, respectively. All these values are in good agreement with those calculated from the equal charge displacement hypothesis. The yield in U^{233} fission was found to be unchanged by a cadmium wrapping, provided that sufficient care was taken in preparation of the irradiated sample. Some discussion of the possible causes of spurious results obtained in preliminary measurements is included. (auth)

3696 CROSS-SECTION RATIOS OF THE Br^{80} ISOMERS IN SOME REACTIONS INDUCED BY 70-160 Mev PROTONS. I. B. Haeller and G. Andersson (Univ. of Uppsala). J. Inorg. & Nuclear Chem., 20: 12-18(Nov. 1961). (In English)

Electromagnetically mass separated sources were used to measure the cross-section ratio $\sigma(Br^{80\,m})/\sigma(Br^{80g})$ as a function of bombarding energy for proton-induced fission of uranium and spallation of yttrium and for the (p, pn) reaction on bromine. In the last-mentioned case the ratio remains constant within error limits, whereas spallation and fission show clearly decreasing and increasing ratios, respectively, when the energy increases from 70 to 160 Mev. (auth)

3697 A NEW RADIOISOTOPE, ^{172}Ta. F. D. S. Butement and G. B. Briscoe (The University, Liverpool). J. Inorg. & Nuclear Chem., 20: 171-2(Nov. 1961). (In English)

One milligram samples of hafnium dioxide (containing 0.6% Zr) were irradiated for 30 min with a 1 μ A beam of 230-Mev protons. A radiochemical separation and purification of tantalum was carried out to eliminate any small amount of radioniobium isotopes derived from zirconium. All the samples, counted with various techniques, showed a new activity with a half-life of somewhat over 20 min. The mean of five determinations gave a half life of 23.6 ± 1.2 min for the new activity, and four determinations gave 1.08 ± 0.05 hr for the next longest activity, which is presumably Ta^{174}. The new 23.6 min tantalum therefore appears to decay by electron capture, with gamma-ray emission, and its most probable assignment is to Ta^{172}, decaying into 5 year Hf^{152}, which would not be observed. (P.C.H.)

3698 NUCLEAR RESONANCE FLUORESCENCE MEASUREMENTS ON THE 845 KEV LEVEL IN Fe^{56}. W. H. Kelly (Michigan State Univ., E. Lansing) and G. B. Beard. Nuclear Phys., 27: 188-92(1961). (In English)

Nuclear resonance fluorescence was observed for the 845−kev level of Fe^{56}. A gaseous source of Mn^{56} as $MnCl_2$ was used in order to utilize the recoil due to previous radiations to compensate for the recoil Doppler broadening of the emission and absorption lines. Resonant self-absorption measurements gave a half life of 6 ± 2 p sec for the state. (auth)

3699 THE RELATIVE DEUTERON/PROTON YIELD FROM 45 MEV BREMSSTRAHLUNG IRRADIATION OF COPPER. Grace P. Ho and Edwin L. Hoff (Ames Lab., Ames, Iowa). Nuclear Phys., 27: 234-47(1961). (In English). (IS-243)

A new method was developed and used to measure the photo-deuteron to photoproton ratio for copper irradiated with 45−Mev maximum energy bremsstrahlung. The photo-particles leaving the 50 μm thick target were deflected by a magnetic field in an evacuated chamber and were detected with nuclear emulsion plates. The particles were identified by using their ranges in emulsion and angles of entrance to retrace their paths back to the target. Of the 1614 tracks detected, 1134 were due to particles from the target. Of these 1114 were identified as protons and only 20 were found to be deuterons, giving a deuteron to proton ratio of 0.018 ± 0.009. This result is not in agreement with the much larger values found for this ratio by other investigators using nuclear emulsion grain-counting techniques and a magnetic cloud chamber method. (auth)

3700 PAIRINGS IN THE SHELL MODEL(III). M. Umezawa (Institut de Recherches Nucleaires, Strasbourg). Nuclear Phys., 27: 248-69(1961). (In English)

Pairing energies are obtained for a system of both kinds of nucleons forming a spherical nucleus. Methods for obtaining the general expression for the Racah fractional parentage coefficients are developed. To do this each Racah fractional parentage coefficient is decomposed into a multiple of a few coefficients. Each of these coefficients is expressed in a form independent of its specific representation, so that the results can be applied to any of the j-j, L-S or intermediate pairing schemes. By using these results, the competition between the spin-orbit force and the pairing forces is dealt with for the following cases: the spin-orbit force is far stronger than the pairing forces (near the j-j limit), the singlet pairing force is far stronger than the spin-orbit force and the triplet pairing force is weak (near the L-S limit). The Bogoliubov method for carrying out the whole procedure described above is sketched, and the results are compared with those obtained by the Racah method. (auth)

3701 COLLECTIVE EFFECTS IN INELASTIC SCATTERING FROM NUCLEI. W. T. Pinkston (Vanderbilt Univ., Nashville) and G. R. Satchler. Nuclear Phys., 27: 270-83(1961). (In English)

It is shown how inelastic scattering is closely analogous to an electric multipole radiative transition, and will show similar collective enhancement. This enhancement will vary with scattering angle. In general, spin-flip transitions are little effected, the enhancement being found in the spin-independent amplitudes; the consequences of this are discussed. The deformed nucleus model for C^{12} is used to illustrate these effects. Finally, the interaction form factors to be used for inelastic scattering are discussed. (auth)

3702 THE γ-RADIATION OF THE $Li^7(p,\gamma)$ RESONANCE AT 441.3 KEV. V. Meyer, H. Mueller, H. H. Staub, and R. Zurmuehle (Univ. of Zurich). Nuclear Phys., 27: 284-93(1961). (In English)

Measurements were made of the intensity ratio, the angular distribution and the α − γ angular correlation of the resonant γ radiation of the reaction $Li^7(p,\gamma)Be^8$. The results, which are in fair agreement with recent values published elsewhere, permit the determination of the channel spin ratio and the three partial γ-ray widths of the 17.6−Mev M1 radiation and the M1 and E2 components of the 14.8−Mev transition. While the value for the 17.6−Mev component agrees well with calculations using the independent particle model, it is shown that the partial

widths of the 14.8-Mev components disagree strongly with the predictions of such a model. It is proposed to explain this discrepancy by the strong collective motion required by the α-particle model for the first excited state of Be^8. (auth)

3703 TWO-BODY FORCES AND THE GIANT RESONANCE IN PHOTO-NUCLEAR REACTIONS. V. V. Balashov, V. G. Shevchenko, and N. P. Yudin (Moscow State Univ.). Nuclear Phys., 27: 323-36(1961). (In English)

Partial cross sections as well as energy and angular distributions of photodisintegration products of the Ca^{40} nucleus are calculated using the shell model. It is shown that the use of empirical data on the levels of the adjacent nuclei and the account of nucleon-nucleon interactions make it possible to describe satisfactorily the photodisintegration of the giant resonance region. (auth)

3704 ROLE OF NUCLEON CLUSTERS IN DEEP PHOTODISINTEGRATION OF LIGHT NUCLEI. V. V. Balashov and V. N. Fetisov (Moscow State Univ.). Nuclear Phys., 27: 337-43(1961). (In English)

General properties of the manifestation of nucleon clusters in photo-nuclear reactions are described, and a theoretical interpretation, in good agreement with experiment, of the reaction $C^{12}(\gamma,pt)2\alpha$ is given. The paper discusses the use of deep photodisintegration for investigating the internal nuclear shells. (auth)

3705 ISOMERIC LEVEL IN Y^{90}. J. M. Ferguson (Naval Radiological Defense Lab., San Francisco). Nuclear Phys., 27: 344-7(1961). (In English)

A 3.5-hr activity was produced by fast neutron bombardment of yttrium and zirconium. The evidence indicates this activity is Y^{90m}. Two gamma rays in cascade were found with energies of 200 and 493 kev. It is felt that the isomer consists of a 7 + level at 693 kev decaying to the 3- level in Y^{90} at 200 kev. (auth)

3706 DEPENDENCE OF THE ANGULAR DISTRIBUTION OF FISSION FRAGMENTS ON THE TARGET NUCLEAR SPIN. V. M. Strutinskii (Strutinski) (Kurchatov Atomic Energy Inst., Moscow). Nuclear Phys., 27: 348-51(1961). (In English)

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 20220.

3707 BETA DECAY MATRIX ELEMENTS IN As^{76}. F. M. Pipkin, G. E. Bradley, and R. E. Simpson (Harvard Univ., Cambridge, Mass.). Nuclear Phys., 27: 353-84 (1961). (In English)

Dynamic nuclear orientation was used to study the $2^- \rightarrow 2^+$ 2.41-Mev β-ray in the decay of As^{76}. The As^{76} was a substitutional donor atom in a silicon crystal and it was oriented by saturating each of the four $\Delta(m_J + m_I) = 0$ forbidden transitions. The angular distribution of the gamma rays following the 2.41-Mev β-ray was measured with two scintillation counters. The electron and nuclear relaxation times were determined by observing the rate of growth and decay of the anisotropy of the gamma rays. The electron ($\Delta m_J = \pm 1$, $\Delta m_I = 0$) relaxation time was (3.6 ± 0.7) min. The nuclear relaxation can be attributed to a modulation of the isotropic hyperfine interaction; the relaxation time for the nuclear polarization is $(3.1 \pm 1) \times 10^3$ min. An analogue computer was used to correct the initial orientation parameters for the effects of nuclear relaxation. From this orientation experiment restrictions can be placed on the angular momentum carried off by the 2.41-Mev β-ray. This result was analyzed in conjunction with β-γ angular correlation and β-γ circular polarization correlation experiments to determine the beta-decay matrix elements. The set which fits the data best is $V = -(0.9 \pm 0.2)$, $Y = -(0.9 \pm 0.2)$. It is not impossible to rule out the set $V = -(18 \pm 5)$, $Y = 0 \pm 4$. (auth)

3708 EFFECTS OF PARITY NON-CONSERVING INTERNUCLEON POTENTIALS ON THE PHOTOEFFECT IN H^2 AND H^3. R. J. Blin-Stoyle (Oxford Univ.) and Herman Feshbach. Nuclear Phys., 27: 395-404(1961). (In English)

Several effects of non-parity conserving potentials on the photodisintegration of the deuteron, on radiative neutron capture by hydrogen and deuterium were estimated employing the non-parity conserving potential. Observation of the correlation of the circular polarization with the direction of emission of the gamma rays emitted in radiative neutron capture by deuterium appears to be the most promising experiment. (auth)

3709 PROTON-PROTON SCATTERING AT RELATIVISTIC ENERGIES. H. S. Green (Univ. of Adelaide). Nuclear Phys., 27: 405-14(1961). (In English)

It is shown that the cross-section for elastic p-p scattering at very high energies can be understood in terms of a hard sphere model for the nucleon, provided the Lorentz contraction of the sphere at relativistic velocities is taken into account. The relativistic mechanics of the collision of hard spheres is discussed on the basis of classical mechanics and wave-mechanics. Already in the classical theory there is some peaking of the angular distribution in the forward direction, which is further accentuated when wave-mechanical interference effects are considered. The behavior of the total cross-section, and the angular distribution for p-p scattering, in the energy range 0.4 to 8.5 Bev, is reproduced satisfactorily by the model. (auth)

3710 AN ISOMERIC STATE OF Y^{90}. C. Carter-Waschek and B. Linder (Florida State Univ., Tallahassee). Nuclear Phys., 27: 415-17(1961). (In English)

An isomeric state of Y^{90} decaying with a half-life of 3.2 ± 0.1 hr was obtained in the bombardment of Rb and Y, respectively, with 12-Mev alphas and deuterons of Tandem Van der Graaff accelerator. The observed gamma peaks can be fitted into an energy diagram with levels at 0.202 ± 0.005 and 0.690 ± 0.003 Mev. Consideration of the shell model and existing decay schemes for Y^{90} leads to the assignment of 7^+ for the isomeric state at 0.690 Mev. (auth)

3711 AN ESTIMATION OF THE SPECTRUM OF TRUE MULTIPLICITIES IN ANTINUCLEON ANNIHILATIONS. E. M. Friedlaender (Inst. of Atomic Physics, Bucharest) and M. E. Mayer. Nuclear Phys., 27: 418-20 (1961). (In Lnglish)

A method is devised for estimating "true" multiplicities of pions in $\bar{p}$-p and $\bar{p}$-n annihilations from observed frequencies of charged prongs, on the basis of isospin and charge conservation. The procedure is illustrated by applying it to available data. (auth)

3712 GAMMA-RAYS FROM INELASTIC SCATTERING OF HIGH ENERGY NUCLEONS. A. B. Clegg ([Oxford Univ.]). and G. R. Satchler. Nuclear Phys., 27: 431-47 (1961). (In English)

It is shown that the angular distribution of de-excitation gamma-rays following the inelastic scattering of high energy nucleons by nuclei can give additional information on both nuclear structure and the effective interaction. Formulas are derived using the impulse approximation; distortion effects due to elastic scattering of incident

and outgoing nucleons are included. A simple case is first discussed in terms of individual scattering amplitudes, then the general formalism is introduced. The effect on the angular distribution of using polarized incident nucleons is also described and shown to give further information about the scattering interaction. (auth)

3713 THE DISINTEGRATION OF B^{10} AND F^{19} BY FAST NEUTRONS. E. A. Davis, F. Gabbard, T. W. Bonner, and R. Bass (Rice Univ., Houston, Tex.). Nuclear Phys., 27: 448-66(1961). (In English)

The disintegration of B^{10} and F^{19} by fast neutrons was studied using a grid-type ionization chamber filled with argon and boron trifluoride enriched in B^{10}. Monoenergetic neutrons for studying the reactions from 0.2 to 8.2 Mev were produced with the $Li^7(p,n)Be^7$, $T(p,n)He^3$ and $D(d,n)He^3$ reactions. Alpha groups from the $B^{10}(n,\alpha)Li^7$ reaction leaving Li^7 in its ground and first excited state at 478 kev were studied over the entire energy range. The cross section for the (n,α) reaction decreased rapidly from 1048 mb at 0.2 Mev to 180 mb at 1.2 Mev and then increased to 451 ± 60 mb at the 1.84-Mev resonance. For higher energies, broad resonance structure was observed with the cross section generally decreasing and reaching a value of 31 mb at 8.2 Mev. The $B^{10}(n,t2\alpha)$ reaction was observed for neutron energies above 1.3 Mev. The cross section for this reaction increased to 80 mb at 4.5 Mev and was comparable to that for the $B^{10}(n,\alpha)Li^7$ reaction above 5 Mev. The $B^{10}(n,t2\alpha)$ reaction was found to proceed mainly by three-body breakup or through the 4.63-Mev excited state of Li^7. Some reactions may have proceeded through the 2.9-Mev level of Be^9 but few, if any, proceeded through the ground state of Be^9. The total excitation function for the $F^{19}(n,\alpha)N^{16}$ reaction leaving N^{16} in the ground and first three excited states was studied for neutron energies above 2.9 Mev. Ten resonances were observed. The cross section increases to 135 ± 50 mb at 5.80 Mev and then decreases at higher energies. (auth)

3714 THE $(p,p'\gamma)$ REACTION IN EVEN ISOTOPES OF Zn, Ge AND Se. D. M. Van Patter, R. Rikmenspoel, and P. N. Trehan (Franklin Inst., Swarthmore, Penna.). Nuclear Phys., 27: 467-89(1961). (In English)

It is possible to study the systematic properties of the second 2+ level in medium-weight even nuclei by investigation of gamma-radiation from the $(p,p'\gamma)$ reaction. For the mass region A = 60-80, the present method of observing $(p,p'\gamma)$ spectra is successful for nuclei whose (p,n) threshold exceeds about 4 Mev. Measurements of the branching ratio of the second 2+ level were made for Zn^{64}, Zn^{66}, Zn^{68}, Ge^{72}, Se^{76}, and Se^{78}, which are in reasonable agreement with available results from radioactivity. New levels were found in Ge^{70} at 1.71 ± 0.01 and 2.16 ± 0.01 Mev. The 1.71-Mev level is considered to be the second 2+ level with a branching (cross-over/cascade) of 0.9 ± 0.1. Information concerning the excitation curves for various $(p,p'\gamma)$ radiations of Zn^{68} and Ge^{70} were obtained for proton energies in the range of 3.0 to 5.2 Mev. (auth)

3715 THE APPLICATION OF DISTORTED WAVE BORN APPROXIMATION CALCULATIONS TO THE ANALYSIS OF SOME (d,p) ANGULAR DISTRIBUTIONS. H. D. Scott (Univ. of Liverpool). Nuclear Phys., 27: 490-506(1961). (In English)

Using distorted wave Born approximation calculations, some proton angular distributions obtained by bombarding the nuclei Na^{23}, Ni^{58}, and Ni^{60} with 9-Mev deuterons were analyzed. It was possible to fit the distributions with unique l-value distorted wave curves in cases where l-value ambiguities have previously existed in the Butler analysis. The reduced widths extracted in both Butler and distorted wave calculations for a particular l-value were compared. The relative values obtained by both methods were found to be generally in good agreement. (auth)

3716 A STUDY OF BETA-GAMMA DIRECTIONAL CORRELATION IN THE DECAY OF Au^{199}. M. S. El-Nesr and R. Othaz (Univ. of Uppsala). Nuclear Phys., 27: 507-15(1961). (In English)

Directional correlation between the 302-kev beta-group and the 158-kev gamma-ray in Au^{199} decay was measured as a function of beta energy. A magnetic lens beta spectrometer was used to select the beta energy. Measurements were made at 89, 127, 164, 187, and 211 kev. Moreover, the directional correlation between the 251-kev beta-group and the 208-kev gamma-ray was studied. Within statistical accuracy of the data the correlations are isotropic. (auth)

3717 DECAY OF Er^{172} AND Tm^{172}. P. G. Hansen, O. J. Jensen, and K. Wilsky (Research Establishment, Risø, Denmark). Nuclear Phys., 27: 516-28(1961). (In English)

The isotopes Er^{172} and Tm^{172} were produced by double n-capture in Er^{170} and isolated by ion exchange chemistry. The radiations were studied mainly by scintillation methods and coincidence techniques. A tentative decay scheme for Er^{172} is given. The Tm^{172} decay scheme includes levels at 79, 260, 1170, 1467, 1550, and 1609 kev. The main β-groups have the following energies (log ft values are given in parentheses) 1920 kev (8.9), 1840 (8.7), 1660 (10.0), 740 (7.9), 450 (6.8), and 310 (6.5). The β-decay to the ground state rotational band shows that Tm^{172} must have spin and parity 2-. This assignment is confirmed from a more detailed consideration of the β-transition probabilities. The single particle configuration for Tm^{172} is discussed. (auth)

3718 TOTAL SLOW NEUTRON CROSS SECTION MEASUREMENTS OF TITANIUM, ZIRCONIUM, AND HAFNIUM. E. G. Joki, J. E. Evans, and R. R. Smith (Philips Petroleum Co., Idaho Falls, Idaho). Nuclear Sci. and Eng., 11: 298-303(Nov. 1961).

Total neutron cross section measurements were made on metallic samples of Ti, Zr, and Hf with the MTR crystal spectrometer. The Ti cross section was measured in the energy region 0.025 to 45 ev and values of 4.19 ± 0.04 b and 6.09 ± 0.13 b were obtained for the bound atom scattering and 2200 meters/sec absorption cross sections. The Zr cross section was measured in the energy region 0.02 to 78 ev and a value of 6.40 ± 0.07 b was obtained for the bound atom scattering cross section. The Hf cross section was measured from 0.04 to 3.5 ev and a value of 102 ± 3 b for the 2200 m/sec absorption cross section was reported. Energy values of 1.095 ± 0.005 ev and 2.378 ± 0.016 ev were determined for the peak cross sections of the first two Hf resonances. Values of σ_0 = 6030 ± 80 b, Γ = 0.068 ± 0.001 ev and $g\Gamma_n$ = 0.163 ± 0.003 mv were obtained for the 1.095 ev resonance. (auth)

3719 PRECISION MEASUREMENTS OF THE NEUTRON TOTAL CROSS SECTION OF U^{235}. A. Saplakoglu (Middle East Technical Univ., Ankara). Nuclear Sci. and Eng., 11: 312-17(Nov. 1961).

A careful measurement is made of the total cross section of U^{235} as a function of neutron energy for neutrons within the energy range 0.004 to 0.4 ev. The cross section at an energy of 0.0253 ev is found to be 694 ± 1.5 barns. (auth)

3720 IRRADIATED Ra:Be NEUTRON SOURCES. D. J. Dudziak and L. B. Freeman (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng., 11: 324-7 (Nov. 1961). (WAPD-T-1248)

An analytical and experimental investigation of irradiated Ra:Be neutron sources was carried out. The significant isotopes in the Ra^{228}, Ac^{227}, and Th^{228} chains are described analytically and the neutron source strengths and γ dose rates are calculated. Comparison with experiment shows a reasonable predictability in most cases. (auth)

3721 A DIFFERENTIAL EQUATION FOR CALCULATING DOPPLER BROADENED RESONANCES. Harvey J. Amster (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng., 11: 343(Nov. 1961).

A differential equation for calculating a Doppler-broadened Breit-Wigner resonance is presented. The equation is used for calculating individual resonance from adjacent values. Boundary conditions for the equation are given. (N.W.R.)

3722 TOTAL CROSS SECTIONS OF HYDROCARBONS AND TISSUE. Robert I. Schermer and Gordon Brownell (Massachusetts Inst. of Tech., Cambridge). Nuclear Sci. and Eng., 11: 345-6(Nov. 1961).

The total neutron cross sections of several organic materials are measured in the energy region 0.015 ev < E < 0.2 ev. The data are to be used in the application of the medical therapy facility at the MIT Research Reactor. Neutron cross sections were studied for formic, acetic, propionic, and butyric acids; ethyl, propyl, and butyl alcohols; methyl-ethyl ketone; and human muscle, brain, and bone tissues. A graphical comparison is shown of the total macroscopic cross section of n-butyl alcohol and muscle tissue to that for water. (N.W.R.)

3723 INTERPRETATION OF THE ISOMERIC CHEMICAL SHIFTS IN Au^{197}. D. A. Shirley (Univ. of California, Berkeley). Phys. Rev., 124: 354-8(Oct. 15, 1961). (UCRL-9700)

The large chemical shifts recently observed in Mössbauer absorption experiments on Au^{197} are explained on the basis of Coulombic interaction between the 6s electron of gold and the $3s_{1/2}$ and $2d_{5/2}$ protons. A first-order perturbation calculation is made, using the Coulombic potential within the nucleus due to the 6s electron. Proton wave functions derived from harmonic-oscillator, square-well, and Woods-Saxon nuclear potentials are treated. The latter two potentials yield results that are in reasonable accord with experiment. This model can afford a sensitive comparison of nuclear potentials as well as a determination of the s conduction-electron density on impurity atoms. In particular, this calculation discriminates against the harmonic-oscillator potential and shows that the 6s electron density on a gold impurity atom in several hosts is higher than in pure gold. These results also indicate that the $3s_{1/2}$ proton subshell is filled in the ground state of Au^{197}. (auth)

3724 NUCLEAR ENERGY LEVELS OF Na^{24} IN THE REGION FROM 630 TO 860 kev. Carl T. Hibdon (Argonne National Lab., Ill.). Phys. Rev., 124: 500-14(Oct. 15, 1961).

An investigation of the nuclear level structure of Na^{24} for neutron energies in the range from 630 to 860 kev revealed the presence of 73 levels distributed throughout the range. Each of the two previously known large peaks was found to be composed of a set of levels. These levels are attributable to values of J up to 7 for the first peak and up to J = 6 for the other one. No s-wave levels were identifiable in this region and it is doubtful that any p-wave levels are present. A set of parameters was determined for the levels by a best fit to the data. These levels were then grouped with those up to 630 kev to obtain a combined total of 230 levels up to 860 kev. The parameters of these levels show the following distributions: an approximate exponential distribution for the level spacings, an approximate exponential or Porter-Thomas distribution for the neutron widths with a tendency to favor the latter, and a distribution of the angular momenta which agrees with the theoretical distribution given by Bloch. Reasonable values of the strength functions were obtained for s- and p-wave levels (0.035 and 0.27, respectively) but the values for $l \geq 2$ appear to be much too large. A plot of the number of levels having energies $\leq E_n$ as a function of E_n shows fluctuations about a linear trend, with no bending away from this trend at high energies to indicate a general missing of levels. (auth)

3725 Li^6 PLUS NEUTRON CONFIGURATION IN Li^7. F. C. Khanna, Y. C. Tang, and K. Wildermuth (Florida State Univ., Tallahassee). Phys. Rev., 124: 515-19(Oct. 15, 1961).

Energy levels of Li^7 are examined in the Li^6 cluster plus neutron configuration. The main purpose is to determine whether a positive-parity level does exist at 6.54 Mev as indicated by some experiments. Results show that the formation of such a state is not favored by the fundamental nucleon-nucleon interaction which yields the deuteron binding energy and explains the s- and p-wave scattering data. The energy of the $^2P_{3/2}$ state was also computed. The resultant value of −27.2 Mev is in fair agreement with the experimental value of −31.7 Mev. (auth)

3726 ONCE-FORBIDDEN BETA SPECTRUM OF Tl^{206}. D. A. Howe and L. M. Langer (Indiana Univ., Bloomington). Phys. Rev., 124: 519-24(Oct. 15, 1961).

The beta spectrum of 4.2-min Tl^{206} was investigated in a 4π scintillation spectrometer. The source was in secular equilibrium with the 2.6×10^6 year Bi^{210} parent. The electron distribution was observed to have a nonstatistical form which could be fitted with a once forbidden pseudovector shape factor. No necessity for the inclusion of any pseudoscalar contribution was observed. The energy release in the Tl^{206} decay is 1.571 ± 0.010 Mev. (auth)

3727 NUCLEAR QUADRUPOLE MOMENT OF Fe^{57m}. Gerald Burns (IBM Research Center, Yorktown Heights, N. Y.). Phys. Rev., 124: 524-6(Oct. 15, 1961).

A value for the nuclear quadrupole moment of the excited state of iron, Q^{57m}, is obtained using published values for eQq/h in the octahedral and tetrahedral sites in $Y_3Fe_2(FeO_4)_3$ (YIG) and in Fe_2O_3, along with recent values for the atomic coordinates in these compounds. The value of Q^{57m} is definitely positive and $\approx +0.4 \times 10^{-24}$ cm^2. (auth)

3728 DECAY OF Ta^{177} AND Lu^{177} TO LEVELS IN Hf^{177}. H. I. West, Jr., L. G. Mann, and R. J. Nagle (Univ. of California, Livermore). Phys. Rev., 124: 527-43(Oct. 15, 1961). (UCRL-6263)

The decays of Ta^{177} and Lu^{177} to levels in Hf^{177} were investigated with beta spectrometers, NaI(Tl) gamma spectrometers, and fast coincidence and angular correlation techniques. Energy levels in Hf^{177} were characterized according to their energy (kev), the Nilsson asymptotic quantum numbers ($Nn_z\Lambda$), the total angular momentum and its component along the symmetry axis (I,K), and the parity (π) as follows: 0[514 7/2, 7/2−]; 112.97[514 9/2, 7/2−]; 249.7[514 11/2, 7/2−]; 321.34[624 9/2, 9/2+]; 447.9[624 11/2, 9/2+]; 420.95[642 3/2, 3/2+]; 488.8[642 5/2, 3/2+]; 585.8[642 7/2, 3/2+]; 509.0[512 5/2, 5/2−]; 605.5[512 7/2, 5/2−]; 746.04[633 7/2, 7/2+]; 848.2[633 9/2, 7/2+]; and 1058.38[503 7/2, 7/2−]. The levels at 447.9, 488.8, and 585.8 kev are tentative. The spins and parities were uniquely determined by angular correlation and internal conversion data for the levels at 746.0 and 848.2 kev, assuming the spins and parities of the levels at 0, 113.0 249.7,

and 321.3 kev are correct as determined from earlier work. For the level at 1058.4 kev the ft value is needed in addition to angular correlation and conversion data in order to determine the spin and parity uniquely. The spins of Lu^{177} and Hf^{177} were previously measured directly as 7/2, and the Ta^{177} spin is expected to be 7/2 on the basis of other tantalum isotopes. The following half-lives were measured: 56.56 hr for Ta^{177}, 0.32 nsec for the level at 113.0 kev, and 0.52 nsec for the level at 321.3 kev. The K/L electron capture ratio to the 1058.4-kev level and the $\beta+$/K-capture ratio to the ground state determine the total decay energy to be 1166 ± 6 kev. (auth)

3729 RADIOCHEMICAL STUDIES OF NEUTRON-INDUCED FISSION OF U^{235} AND U^{238} AND THE TWO-MODE FISSION HYPOTHESIS. H. B. Levy, H. G. Hicks, W. E. Nervik, P. C. Stevenson, J. B. Niday, and J. C. Armstrong, Jr. (Univ. of California, Livermore). Phys. Rev., 124: 544-51(Oct. 15, 1961). (UCRL-6252)

It is suggested that the effect of changing excitation energy on the shape of the fission product mass-yield curve from fission of a single nuclear species is due to the change in the relative amounts of two energy-independent modes of fission, each giving rise to its own characteristic mass-yield curve. It is shown that this hypothesis predicts a linear relationship between the fission yields of any pair of fission products measured at a set of excitation energies. Linear relationships are also predicted between pairs of fission yields measured relative to the yield of some reference fission product. Fission product yields relative to the fission yield of Mo^{99} were measured for fission of U^{235} and of U^{238} with neutron beams of mean energies ranging from 2 to 10 Mev. The predicted linear relationships were observed in all cases. However results for fission yields from U^{235} with thermal neutrons do not fall on the corresponding observed lines. The two-mode fission hypothesis is a possible explanation for the linear relationships observed but does not explain all of the data. (auth)

3730 MAGNETIC MOMENTS OF MIRROR NUCLEI. Dieter Kurath (Argonne National Lab., Ill.). Phys. Rev., 124: 552-4(Oct. 15, 1961).

The sum of the magnetic dipole moments for pairs of mirror nuclei, as calculated with intermediate-coupling functions in the 1p shell, is found to be very insensitive to the degree of spin-orbit coupling. This property can be understood as being due to the rotational nature of the wave functions, and can also be interpreted in terms of wave functions from the Nilsson model. Magnetic dipole moments are predicted for those nuclei which were not measured. (auth)

3731 THEORY OF NUCLEAR MATTER. Franz Mohling (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 124: 583-601(Oct. 15, 1961).

The methods of quantum statistics previously developed by the author are applied to the determination of properties of the ground state of nuclear matter. An expansion in powers of the pair-function of quantum statistics is made and expressions are derived for the momentum distribution, pair-correlation function, binding energy, and effective single-particle energies. The leading terms of these expressions can be interpreted in terms of an effective two-body interaction, and a model of nuclear matter which consists of interacting quasi-particles whose energies are the effective single-particle energies is thereby suggested. The theory is compared with Brueckner's theory and also with Landau's phenomenological theory of the Fermi liquid. (auth)

3732 NUCLEAR SPECIFIC HEAT OF HOLMIUM. J. E. Gordon, C. W. Dempesy, and T. Soller (Amherst Coll., Mass.). Phys. Rev., 124: 724-5(Nov. 1, 1961).

The specific heat of holmium is measured between 0.95 and 4.2°K. The magnetic hyperfine interaction in holmium is so large that over this entire temperature range the nuclear hyperfine term represents the predominant contribution to the specific heat. Below 1.5°K the specific heat appears to be that of an ideal paramagnetic gas of spin $^7/_2$. At 1°K the specific heat has the extremely large value of 0.37R. (auth)

3733 HYPERFINE STRUCTURE OF DIVALENT AND TRIVALENT Fe^{57} IN COBALT OXIDE. G. K. Wertheim (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. Rev., 124: 764-7(Nov. 1, 1961).

The hyperfine structure of divalent and trivalent iron in CoO is obtained from the Mössbauer effect of Fe^{57} produced by the electron-capture decay of Co^{57}. The two valence states are obtained respectively by x ray and Auger effect de-excitation of the K-shell hole resulting from electron capture in divalent Co^{57}. Higher valence states which could be produced by multiple Auger de-excitation are not observed, indicating that their lifetimes are short. The magnetic field at a divalent iron nucleus at low temperature is 2.0×10^5 gauss, while that at a trivalent one is 5.6×10^5 gauss. The quadrupole coupling in this almost cubic environment is less than 1.0 Mc. (auth)

3734 PRESSURE, LIGHT, AND TEMPERATURE SHIFTS IN OPTICAL DETECTION OF 0–0 HYPERFINE RESONANCE OF ALKALI METALS. M. Arditi (ITT Federal Labs., Nutley, N. J.) and T. R. Carver. Phys. Rev., 124: 800-9(Nov. 1, 1961).

Measurements of the hyperfine splitting of Cs^{133} or Rb^{87}, in a cell with buffer gases and using optical pumping, show a frequency shift when the intensity of the exciting resonance light is varied. Use of high buffer gas pressure reduces considerably the light intensity shift. Also, in some cases, the magnitude and sign of the light intensity shift can be changed appreciably by varying slightly the frequency of the hyperfine components of the exciting light. Tentative explanations of the light shift are discussed. Frequency shift variations with light intensity, buffer gas pressure, and temperature of the cell show the existence of an invariant point whose frequency, when reduced to zero pressure and zero field, is very close to the value obtained by the atomic beam resonance method. This invariant point is the basis for a definition of the pressure shift and temperature shift coefficients. Experimental determination of these coefficients is given for Cs^{133} and Rb^{87}. (auth)

3735 EXCITATION PROCESSES IN HELIUM INDUCED BY IMPACT OF DEUTERONS AND PROTONS. Z. Šternberg and P. Tomaš (Inst. Ruder Boskovic, Zagreb,). Phys. Rev., 124: 810-13(Nov. 1, 1961).

The excitation of helium atoms by impact of protons and deuterons is examined from 40 to 200 kev. The cross sections of some ^1S, ^1D and the 3 ^1P state are determined. The excitation of the 2 $^1P-4$ ^1S line attains a broad maximum at 65 kev for protons, and at 115 kev for deuteron excitation. The 3 ^3D state appears to be weakly populated by direct deuteron excitation; at 130 kev deuteron energy, $Q(3^3D) \leq 2 \times 10^{-20}$ cm^2. Inelastic collisions between excited helium and foreign atoms bringing about the transition from singlet to triplet states are discussed. (auth)

3736 PARTIAL WIDTHS OF THE 16.11-MEV STATE IN C^{12}. R. E. Segel and M. J. Bina (Aeronautical Research Lab., Dayton, Ohio). Phys. Rev., 124: 814-17(Nov. 1, 1961).

The alpha spectrum, gamma spectrum, and the ratio of gamma to alpha yield are measured for the 163-kev $B^{11} + p$ resonance that forms the 16.11-Mev state in C^{12}. The results are combined with the total width and gamma yield to

give values for the gamma widths, the partial alpha width for decay to the Be^8 ground state, and the proton width. The values found for the partial widths are shown to be in agreement with the independent-particle model predictions. (auth)

3737 DIFFERENTIAL CROSS SECTIONS FOR $O^{16}(d,n)F^{17}$. B. Yaramis (Columbia Univ., New York). Phys. Rev., 124: 836-8(Nov. 1, 1961).

The absolute differential cross sections for neutrons from the $O^{16}(d,n)F^{17}$ reaction which leave F^{17} in its ground and first excited state (0.5-Mev) level are obtained using a gas-recoil fast neutron spectrometer and CO_2 gas targets. The estimated target thickness is about 150 kev and the average bombarding energy at target center is 5.02 Mev. An $L_p = 2$ distribution is found for the ground state and an $L_p = 0$ distribution for the 0.5-Mev level, with c.m. differential cross sections at peak of 27 and 138 mb/sr respectively, with estimated uncertainties of ±15%. The dimensionless reduced width θ^2 obtained from the differential cross section for neutrons that leave F^{17} in its ground state is approximately 0.025. Agreement of theoretical curves with the experimental points is poor at small angles. The value of θ^2 for the 0.5-Mev level is found to be 0.15. Since C^{12} is present in the target, laboratory system differential cross sections at 0, 20, and 30 for the $C^{12}(d,n)N^{13}$ reaction (2.37-Mev) level are reported. (auth)

3738 TWO-BODY POTENTIAL IN NUCLEAR MATTER. D. C. Peaslee (Australian National Univ., Canberra, Australia). Phys. Rev., 124: 839-41(Nov. 1, 1961).

An effective two-nucleon central potential inside nuclear matter is proposed on the basis of an analysis of doublet splittings for $A \approx 16$. This potential has less singlet even and more singlet odd attraction than for free nucleons. It is inferred that nonlocal potentials are unavoidable for shell model calculations. (auth)

3739 BETA-GAMMA DIRECTIONAL CORRELATION IN THE DECAY OF Eu^{154}. L. D. Wyly, E. T. Patronis, Harry Dulaney, and C. H. Braden (Georgia Inst. of Tech., Atlanta). Phys. Rev., 124: 841-5(Nov. 1, 1961).

The directional correlation for the (1855 kev-beta) (123 kev-gamma) cascade in the decay of Eu^{154} is measured. The directional correlation coefficient A_2 varies from −0.15 at a beta energy of 1100 kev to −0.18 at a beta energy of 1600 kev. In terms of a single nuclear matrix element parameter, ζ_1, the directional correlation suggests $\zeta_1 = 2.6$ or −0.2 while the beta spectral shape correction suggests $\zeta_1 = 1.3$. The results suggest that the attenuation of ordinary first-forbidden matrix elements relative to B_{ij} is less marked in Eu^{154} than in the comparable transition in Eu^{152}. Interpretation of the data in terms of a less restrictive formulation of the theory is investigated. Relations between matrix element ratios may be found but no unique set of matrix element ratios is demanded by the experimental data. (auth)

3740 FISSION FRAGMENT ANISOTROPY AND PAIRING EFFECTS ON NUCLEAR STRUCTURE. R. Vandenbosch, H. Warhanek, and J. R. Huizenga (Argonne National Lab., Ill.). Phys. Rev., 124: 846-53(Nov. 1, 1961).

The dependence of the angular distributions on projectile energy for helium-ion-induced fission of Th^{232}, U^{233}, and U^{238} is investigated using solid-state fission fragment detectors. The measurements cover the range of projectile energies between 20 and 43 Mev in steps of 1 Mev or less. The energy dependence of the anisotropy has a structure that is in qualitative agreement with theoretical predictions. The most fissionable target studied, U^{233}, shows the least structure while the least fissionable target, Th^{232}, shows the most structure, demonstrating that large anisotropies result from fission occurring at low excitation energy following neutron emission from the compound nucleus. The energy dependence of K_0, the standard deviation of the distribution in the angular-momentum projection on the nuclear symmetry axis at the saddlepoint, is deduced from these data, and data on angular distributions from neutron-induced fission. At high excitation energies K_0 is consistent with predictions of statistical theory with a moment of inertia close to that of a rigid rotator. At excitation energies in excess of the fission threshold of 10 Mev or less, K_0 is much reduced due to nuclear pairing effects. (auth)

3741 GAMMA-RAY STUDIES IN BORON-10. Esther L. Sprenkel and James W. Daughtry (Aeronautical Research Lab., Dayton, Ohio). Phys. Rev., 124: 854-9(Nov. 1, 1961).

Gamma rays from the 7.56 Mev level of B^{10} were analyzed with a five-crystal pair spectrometer. Cascade gamma rays were investigated by recording the spectra in coincidence with the 2.40, 0.72, 2.15, and 5.41-Mev gamma transitions. The branching ratios for the decay of the 7.56-Mev level were found to be 76, 9, and 15% for 6.84, 5.41, and 2.40-Mev gamma rays, respectively. For the 2.15-Mev level, the respective branching ratios for 2.15, 1.43, and 0.41-Mev gamma rays were shown to be 16, 29, and 55%. The partial width ($\Gamma_{\gamma 3.01}$)for the 3.01-Mev transition was found to be less than 1% of the total width (Γ) of the 5.16-Mev state in B^{10}. The gamma width of the 5.16-Mev level was found to be 0.51 ev and the alpha width $32 < \Gamma_\alpha < 500$ ev. Although the upper limit for the alpha width of the 5.16-Mev level was quite small, this result was shown to be consistent with the alpha transition being isotopic-spin-allowed. The conflict between the result $\Gamma_{\gamma 3.01}/\Gamma < 0.01$ and evidence requiring larger relative partial gamma widths may be resolved if the 5.16-Mev state in B^{10} is assumed to be a doublet. (auth)

3742 SELF-CONSISTENT NUCLEAR MODEL. Balazs Rozsnyai (Univ. of California, Berkeley). Phys. Rev., 124: 860-7(Nov. 1, 1961).

A proposed Hamiltonian is applied to carry out self-consistent calculations for atomic nuclei. Average exchange forces, calculated from a plane-wave model, are included in the Hartree potential. In order to obtain agreement with the empirical data, two coupling constants and one constant representing the range of the interaction have to be adjusted. The range turns out to be 3.23×10^{-14} cm. Because this range is very short the calculations may not be justified and must be considered as a formal procedure. Having adjusted the three parameters, neutron and proton binding energies and nucleon densities are calculated for the nuclei O^{16}, Ca^{40}, Ce^{140}, and Pb^{208}. (auth)

3743 N^{14} + He^4 AND O^{16} + He^3 DIFFERENTIAL CROSS SECTIONS. E. A. Silverstein, S. R. Salisbury, G. Hardie, and L. D. Oppliger (Univ. of Wisconsin, Madison). Phys. Rev., 124: 868-76(Nov. 1, 1961).

Thin (~2 kev) gas targets are used for high-resolution studies of $N^{14}(\alpha,\alpha)N^{14}$ differential cross sections for $1.0 < E_\alpha < 2.4$ Mev. Resonances are observed at $E_\alpha = 1.533$, 1.620, 2.165, 2.351, and 2.370 Mev. The Wigner-Eisenbud formalism is used to extract resonant parameters (where possible) of the corresponding virtual states of F^{18}. Also, $O^{16}(He^3,He^3)O^{16}$ and $O^{16}(He^3,He^4)O^{15}$ differential cross sections are measured for $1 < E_{He^3} < 3$ Mev. A 300 kev broad resonance at $E_{He^3} = 2.360$ Mev is shown to result from a $\frac{1}{2}^+$ state of Ne^{19}. The elastic width is 0.11 of the total width. (auth)

3744 ALPHA PARTICLES AND PROTONS EMITTED IN THE BOMBARDMENT OF Au^{197} AND Bi^{209} BY C^{12}, N^{14},

AND O^{16} PROJECTILES. Harold C. Britt and Arthur R. Quinton (Yale Univ., New Haven). Phys. Rev., 124: 877-87(Nov. 1, 1961).

Angular distributions, energy spectra, and absolute cross sections are measured for alpha particles emitted in the bombardment of Au^{197} and Bi^{209} by C^{12}, N^{14}, and O^{16} projectiles at bombarding energies of 10.5 Mev/nucleon, and for the C + Bi reaction at energies of 8.7 and 7.1 Mev/nucleon. Angular distributions and absolute cross sections are also measured for protons from the C + Bi and O + Bi reactions at energies of 10.5 Mev/nucleon. It is found that, from the angular distributions and energy spectra, it is possible to separate the contributions from direct and evaporation processes. The direct alpha particle results suggest that the principal direct process involved is the breakup of the incident projectile in an interaction with the surface of the target nucleus. At 10.5 Mev/nucleon energies, the cross sections for the emission of direct protons and direct alpha particles are found to be about 10% and 25 to 35%, respectively, of the calculated total reaction cross sections. The evaporation cross sections depend strongly on the excitation energy available in the compound system. The evaporation energy spectra can be fitted by an expression of the form $\exp(-E_\alpha/T)$ and the results yield an average level density parameter, $\alpha = 22 \pm 2$ Mev^{-1}, for these reactions. (auth)

3745 STABILITY OF NUCLEAR OCTUPOLE DEFORMATION. Ila Dutt and Paresh Mukherjee (Saha Inst. of Nuclear Physics, Calcutta). Phys. Rev., 124: 888-9 (Nov. 1, 1961).

The effect of octupole deformation on the single-particle energy levels is investigated by an exact diagonalization method, and the total single-particle energies for a number of rare-earth and actinide nuclei are calculated. It is found that while in the rare-earth region a stable octupole deformation is possible energetically, the favored shape for the actinide nuclei is a prolate spheroid. (auth)

3746 CYROGENICS AND NUCLEAR PHYSICS. Solid-State and Nuclear Physics Advance Together Through Research at Ultralow Temperatures. R. P. Hudson (Oxford Univ.). Science, 134: 1733-6(Dec. 1, 1961).

Static and dynamic methods for orienting nuclei at low temperatures are reviewed. The effects of nuclear orientation on α-, β-, and γ- emission angular distributions are outlined. Attention is devoted to β decay and parity nonconservation. The achievement of "nuclear cooling" by a method analogous to that used in the isentropic demagnetization of paramagnetic salts is described. (T.F.H.)

3747 THE OPTICAL MODEL OF THE NUCLEUS IN THE LIGHT OF RECENT DATA. I. S. Shapiro. Uspekhi Fiz. Nauk, 75: 61-100(Sept. 1961). (In Russian)

The optical model of the nucleus predicts that nucleons are scattered by nuclei almost in the same way that light is scattered by a semi-transparent optical medium. Recent experiments indicate that the nucleus is almost as transparent for heavy particles as it is for nucleons. The scattering of nucleons by heavy nuclei can be considered as the diffraction of a nucleon wave at a certain potential. Thus, scattering is not a problem of many bodies, but a problem of the motion of a nucleon in a certain field created by the nucleus that does not depend on time. An optical model having a continuous but sharp drop in nuclear potential is assumed most frequently: $V(r) = V_0 f(r)$ where $f(r) = [1 + \exp(r-R)/a]^{-1}$. The rate of fall of the potential is characterized by $a = 0.65 \times 10^{-13}$ cm. The "radius of the nucleus" $R = 1.27 \times 10^{-13}$ cm $A^{1/3}$. The parameters R, a, and V_0 are so selected as to obtain good agreement with experimental values for the total cross-section σ_t, the capture cross-section σ_c and the differential scattering cross-section $d\sigma_s(\theta)$. The scattering of 14-Mev neutrons is satisfactorily explained in this way. The introduction of a surface potential improves the agreement between theory and experiment. Spin-orbital coupling is also taken into account to explain the polarization of 14-Mev neutrons and 10-Mev protons as a function of the angle of scattering θ. The scattering of 48.2-Mev alpha particles, 15-Mev deuterons, 165-Mev O^{16} particles, and 27.3-Mev N^{14} particles is discussed from the point of view of the optical model of the nucleus. It is concluded that nuclear matter is relatively transparent to not only nucleons but also to heavy particles. (23 references) (TTT)

3748 SOVEREMENNYE MODELI ATOMNOGO YADRA. (Contemporary Models of Atomic Nuclei). P. E. Nemirovskii. Moscow, Atomizdat, 1960. 302p.

Problems related to nuclear properties and structure are investigated. Particular attention is given to the theory of nuclear models, the optical and collective models, and to deuteron stripping reactions. The first, second, third, and sixth chapters are based on published data while the fourth and fifth chapters include original work. 390 references are included. (R.V.J.)

3749 ON THE SPECIAL ROLE OF OPTICAL BRANCHES IN MOSSBAUER EFFECT. Yu. Kazan. Zhur. Eksptl'. i Teoret. Fiz., 41: 659-61(Aug. 1961). (In Russian)

Effects of crystal optical branches on Mossbauer effects are analyzed, and a partial explanation for the abnormal temperature dependence of the Mossbauer effect in SnO_2 and Dy_2O_3 is derived. (R.V.J.)

3750 NON-CONSERVATION OF PARITY IN STRONG INTERACTIONS AND FISSION OF NUCLEI. V. V. Vladimirskii and V. N. Andreev (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 663-5(Aug. 1961). (In Russian)

An attempt was made to determine nonconservation of parity in strong interactions, anticipating an admixture with parity nonconservation of $\sim fg/hc \approx 10^{-7}$. Various forbiddenness interfering with transitions with parity conservation are analyzed. Nuclear fissions are also analyzed for nonconservation of parity in strong interactions. (R.V.J.)

Particle Accelerators

Refer also to abstract 3284

3751 (BNL-5788) DRIFT TUBE ACCELERATOR. A. Tranis (Brookhaven National Lab., Upton, N. Y.). Oct. 20, 1961. Contract [AT(30-2)-Gen-16]. 8p.

It was proposed that the existing broad band accelerating system be replaced by a drift tube accelerator. Measurements on a $^1/_8$ scale model of the drift tube and feed leads showed that the equivalent circuit of the full scale drift tube and leads can be represented by a series combination of leakage inductance equal to 9.55×10^{-9} hy and capacitance equal to 165 pf. The geometry of the tuning stub is shown. Maxwell's equations were solved for this geometry under the conditions that no H_z or H_r exist, no E_θ field exists, $d/d_\theta = 0$, and $E_r = 0$ in the ferrite. (M.C.G.)

3752 (CERN-61-24) TO THE OBSERVED SYNCHROTRON MODULATION OF EXCITED BETATRON OSCILLATIONS IN THE CPS. M. Geiger (European Organization for Nuclear Research, Geneva). Sept. 8, 1961. 23p.

Beam betatron oscillations in a synchrotron are discussed. At small amplitudes conditions are realized where these oscillations, once excited, do not decay for reasons

of dispersion due to the existing energy spread, but rather persist. The characteristic feature is that the beam oscillations appear modulated in amplitude and that the periodicity of the modulation is given by the synchrotron oscillation frequency. This effect was produced with the CPS on several occasions and is explained and calculated as a mechanism based on two things: the particle confining bunch structure of the beam, and the phase slip of the particle oscillations due to the Q-spread associated with the energy spread present. From the theory and the observed beam pick-up signal conclusions were drawn as to the bunch shape, the particle distribution, and the Q-spread. As a consequence, the synchrotron oscillation frequency may be checked during operation of the CPS, by using the r.f. knock-out device. (auth)

3753 (UCOL-P-508) PROGRESS REPORT [ON THE CYCLOTRON]. (Colorado. Univ., Boulder). Nov. 9, 1961. Contract AT(11-1)-535. 26p.

The design, testing, and fabrication of the Colorado University FFAG cyclotron are summarized. Attention is devoted to: measuring the magnetic field of the shims, central spider, and plates incorporated in the cyclotron; orbit computations; preparation of the shim coils, power supplies, and shielding; development of the r-f system, ion source, beam deflector, vacuum systems and electronic counting instrumentation; external beam handling methods; experimental equipment and projected programs; and a nuclear physics laboratory for use in conjunction with the cyclotron. Results of a nuclear spectroscopy program are summarized. The energy levels of Mn^{52} are outlined. (T.F.H.)

3754 PHYSICAL RESEARCH AT THE CYCLOTRON LABORATORY OF THE I. V. KURCHATOV ATOMIC ENERGY INSTITUTE. N. A. Vlasov and S. P. Kalinin. Atomnaya Energ., 11: 345-55(Oct. 1961). (In Russian)

The cyclotron built in 1947 was originally designed to accelerate deuterons and molecular H ions to 14 Mev and α particles to 28 Mev. Modifications carried out in 1950 allowed focussing of the beam on targets a distance of 12 m. At present the beam current on 1 cm^2 of target area reaches values of several tens of microamps being limited primarily by the cooling requirements of the target and by radiation safety considerations. The Nuclear Physics Laboratory, organized in 1953, was first involved in cross section determinations of various radioactive isotopes. Subsequent work included fast neutron spectrometry by the time-of-flight method and study of reactions accompanying the formation of tritium. Stabilization of the frequency of the accelerating voltage was achieved by using a quartz generator which controlled the frequencies of the reactive parameters of the resonance system. Results of the study of the pulse distribution in time of the Li + d (10 Mev) reaction, dependence of the differential cross section of the $T(p,n)He^3$ reaction on the proton energy, the time distribution of the Th^{232} fission pulses by neutrons from the D(d,n) reaction at 19.5 Mev are listed. Among the nuclear reactions studied, the following are mentioned: removal of neutrons from completed shells of the nucleus in case of the (d,t) reactions of Zr isotopes and of the $O^{18}(d,t)O^{17}$ and $F^{19}(d,t)F^{18}$ reactions. (23 references) (TTT)

3755 ION CAPTURE AND INITIAL ORBITS IN KARLSRUHE ISOCHRONOUS CYCLOTRON. Martin Reiser (AEG-Forschungsinstitut, Frankfurt am Main). Nuclear Instr. & Methods, 13: 55-69(Aug. 1961). (In German)

Theoretical and experimental studies are carried out on the problem of ion capture, initial orbits, and optimum field configuration in the center of the Karlsruhe Isochronous Cyclotron (50 Mev deuterons). The theoretical studies including calculations on vertical focusing and ion paths on the first turns proved that excellent beam quality could be expected for special geometrical conditions. A group of ions starting in the phase interval, before the peak dee voltage is reached, is strongly bunched in radius, energy, and orbit centers and is also vertically well focused by electric and magnetic forces. For experimental investigation a full scale 45 cm proton model cyclotron of the center of the big machine is constructed. The results obtained in the experiments are in good agreement with the theory. (auth)

3756 ANNULAR PHASATRON WITH RADIAL SECTORS. F. Benda, I. Gobanets, I. Dobiash, A. A. Zhuravlev, M. Karmasin, V. I. Kotov, M. Marek, E. A. Myae, Yu. L. Obukhov, V. A. Petukhov, L. V. Svetov, V. Sokhor, T. Fukatko, and Yu. Tsirak. Zhur. Tekh. Fiz., 31: 1253-61(Oct. 1961). (In Russian)

The performance of an annular phasatron is described, and data are given on the adjusting and starting operations. (R.V.J.)

3757 USKORITELI. SBORNIK STATEI. (Accelerators. Collection of Articles). G. A. Tyagunov, ed. Moscow, Atomizdat, 1960. 164p.

Fifteen papers are included on theoretical and experimental studies of linear electron accelerators, betatrons, and synchrotrons. Experimental investigations deal with ion sources for cyclotrons, measurements at superhigh frequencies, and with electron accelerator and betatron components. A special study is made of the linear cyclic accelerator (elutron). Theoretical papers on particle trapping in synchrotrons and betatrons contain a mathematical solution for this problem which takes into account the collective interactions of particles in the beam and the inductive properties of the beam. (R.V.J.)

Plasma Physics and Thermonuclear Processes

Refer also to abstract 3889

3758 (AD-257416) THERMAL AND ELECTRICAL CONDUCTIVITIES IN A PLASMA. A PHENOMENOLOGICAL APPROACH (thesis). William R. Conway (Florida State Univ., Tallahassee). Aug. 1961. 31p.

A phenomenological approach was developed for the problem of the evaluation of the conductivities, both thermal and electric, in a plasma. A time of relaxation in the transport process was applied. The collision term of the basic transport equation was replaced by terms which represent displacements in velocity space from an equilibrium distribution, toward which the plasma tends to return. The phenomenological method results in expressions containing two adjustable parameters. These expressions fulfill the physical requirements of dependence on temperature, particle concentration, and degree of ionization. (M.C.G.)

3759 (AD-257441) KINEMATIC FORMULATION OF ROTATIONAL FLOW IN MAGNETOGASDYNAMICS. Marcel Vinokur (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). May 1961. 24p.

For presentation at the Fourth Biennial Gas Dynamics Symposium, August 23-25, 1961, at Northwestern University.

The steady, rotational flow of a perfectly conducting, ideal gas in the presence of a magnetic field was studied. A kinematic formulation, a reduction of the original equations describing the flow to a form in which the velocity is

the only dependent variable, was sought. This formulation was made for two cases: plane flow in a transverse magnetic field and three-dimensional flow in which the magnetic field is parallel to the velocity everywhere. In both cases the kinematic formulation led to a single vector equation whose solution completely determines the flow. The explicit form of the equation was derived for a perfect gas and was found to be independent of the strength of the magnetic field in both cases. In the parallel field case, it was necessary to employ a transformation due to Peyret which reduced the magnetogasdynamic flow to an ordinary gasdynamic flow of a fictitious gas. The form of the resulting kinematic equation was found to depend only on the Mach number of the original flow, the critical Mach numbers being $\sqrt{(6/\gamma + 7)}$, 1, and $\sqrt{(3/2-\gamma)}$. (auth)

3760 (AD-257912) ION CLOUDS AND PLASMA PHENOMENA. Period [covered]: January 1958–January 1960. (Library of Congress. Air Information Div., Washington, D. C.). May 19, 1961. 13p. (AID-61-68).

A bibliography of materials received at the Air Information Division is presented. Sixteen references with abstracts are included. (J.R.D.)

3761 (AFOSR-566) STUDY OF THE DISTURBANCE CAUSED BY A MOVING BODY IN A PARTIALLY IONIZED GAS. F. Marcel Devienne and A. Roustan (Laboratoire Mediterraneen de Recherches Thermodynamiques, Nice). Jan. 1961. Contract AF61(052)-124. 113p. (AD-258301)

The existence of electrical phenomena occurring in the vicinity of the trajectory of a moving body in a partially ionized gas was investigated. The studies were carried out under free molecular flow regime. The device for the production of the ionized gas consists of a quartz tube penetrating the vacuum tank and wrapped with a self-induction coil through which is passed a high-frequency current. The electrical phenomena manifest themselves by a disturbance having a specific form and well-defined characteristics. The factors causing variation in the duration and relative intensity of the disturbance were determined. (M.C.G.)

3762 (AFOSR-1618) SHOCK WAVE STRUCTURE IN A FULLY IONIZED GAS BASED ON MULTI-COMPONENT FLUID THEORY. Technical Report No. 14. Huon Li and Richard D. Mathieu (Pennsylvania State Univ., University Park). Sept. 1961. Contract AF49(638)-647. 63p.

The multi-component continuous approach for the investigation of the gasdynamics of a plasma appeared to be very useful. More information about the flow properties of a plasma could be obtained than from the classical magnetohydrodynamic approach. Also, the resulting equations appeared to be more easily solved than the Boltzmann equation of classical kinetic theory. The basic macroscopic conservation equations for a non-reacting multi-component plasma are presented. The fluid properties of each component are referred to the mean velocity of that component. Therefore, no limitations are placed on the magnitude of the diffusion velocities. The effects of electric and magnetic fields are included. The equations for a two-component mixture were used to study the structure of a shock wave in a fully-ionized hydrogen gas. It was assumed that the momentum exchange and energy exchange between the ions and electrons are important because of the strong Coulomb forces which are present. Thus, the effects of viscosity and thermal conductivity were neglected. The phenomenon of charge separation gave rise to an induced electric field within the plasma. For a Mach number of 1.12 and typical plasma conditions, the electric field was on the order of 12,000 volts/cm. At this low Mach number, the fluid properties of the ions and electrons varied in an oscillatory manner through the shock wave. As the mean-free path between particles decreased, the oscillations damped out more rapidly and at the same time the oscillations became less frequent. The existence of these oscillatory features and large electric fields within the plasma might very well play an important part in many plasma phenomena. (auth)

3763 (GA-2344) FISSION OF A HOT PLASMA. Norman Rostoker and Alan C. Kolb (General Atomic Div., General Dynamics Corp., San Diego, Calif.). July 31, 1961. 17p. Contract [AT(04-3)-187].

The plasma formed in a fast B_z compression develops an instability after about a 4 to 5 μsec quiescent period. The consequence of the instability is that the plasma fissions into two well defined filaments that rotate with an angular velocity $\Omega \sim 10^7$ sec^{-1}. This configuration was observed for many rotational periods. The plasma appears to remain confined, although impurity radiation indicates that some plasma reaches the walls during the fission process. The fission process in a deuterium plasma is accompanied by a rapid decline in neutron production. The origin of the rotation and the development of the instability are discussed. (auth)

3764 (LMSD-894830) PLASMA ACCELERATION WITH COAXIAL ELECTRODES. Philip J. Hart (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). May 1961. 42p. (AD-257819)

The acceleration of a plasma by a capacitor discharge between coaxial electrodes is investigated theoretically and experimentally. Simultaneous differential equations are written for two cases, in which the electrodes are used in a shock tube having a uniform gas distribution for a simple "snowplow" model of plasma motion; or the electrodes are used to accelerate a constant mass of plasma into a vacuum. The equations are solved by analog computer for the plasma displacement, velocity, acceleration, the current and its derivatives, and various power terms, as functions of time. For the first case, plasma velocities and displacements, measured from streak photographs for several experimental arrangements, compare favorably with computer-predicted velocities until the peak velocity is attained. At this instant, which is the assumed limit of validity of the equations, a shock wave detaches from and moves ahead of the plasma disk. The actual current distribution in the space between the electrodes, as determined by a "difference" magnetic probe, is found to be rather complex, with current loops forming after the peak velocity is attained. Effects caused by a distributed current are discussed. (auth)

3765 (NOR-61-26) STUDY OF GENERATION OF COHERENT ELECTROMAGNETIC RADIATION BY A PULSATING PLASMA. R. W. Sampson, R. A. Kinney, and K. H. Kriz (Norair. Div. of Northrop Corp., Hawthorne, Calif.). Feb. 20, 1961. Contract AF30(602)-2354. 126p. (RADC-TR-61-77; AD-258090)

Considerable time and effort was devoted to a previously suggested scheme of coherent radiation from plasma surface vibrations, with charge separation in a thin boundary sheath, and that effort has been the subject of critical evaluation. A synopsis is given of results of that review, which led to the conclusion that the proposed scheme cannot be substantiated on theoretical grounds. An independent calculation was made to obtain an order of magnitude estimate of radiation that might be expected from plasma surface oscillations with realizable charge separation under the most optimistic conditions. This calculation based upon the oscillation of surface dipoles indicates that the rate is negligible. The calculation is outlined with the approxima-

tions used, and practical considerations are summarized. The possibility of utilizing the volume oscillations in a plasma is suggested, and their use as a more reasonable approach to the problem, both from the physical and the theoretical point of view, is discussed. Because of potential military applications of coherent radiation from a plasma source, this approach merits consideration as a desirable subject and a worthwhile objective of further research. An exploratory research program including theoretical support is described for determining experimentally the intensities and coupling of non-radiating and electromagnetic waves in plasmas and the magnitude of radiation from plasmas, which are not predictable by present theory partly because it is limited to linearized analyses. This experimental program considers means for obtaining coherent radiation from plasmas both directly, and indirectly through the agency of external coupling circuits, and various methods of excitation and modes of transverse and longitudinal waves are to be investigated. (auth)

3766 (NP-11070) STABILITY OF RELATIVISTIC SELF-FOCUSING STREAMS. D. Finkelstein and P. A. Sturrock (European Organization for Nuclear Research, Geneva and Brookhaven National Lab., Upton, N. Y.). Feb. 18, 1959. 27p. (PS/Int. AR 59-2).

Revision of PS/Int. AR 58-3.

Instabilities of self-focusing relativistic plasma streams are considered. Calculations are based on the construction of simple models which suppress or approximate the coupling between various degrees of freedom. The following modes of possible instability are discussed: the two-stream longitudinal plasma-oscillation mechanism; negative-mass instability, which is associated with the plasma-oscillation mechanism in circular beams below phase-transition; varicose, sausage, instability; and sinuous, bending or kink, instability. Increasing beam energy tends to suppress all these instabilities except the negative-mass instability which might however be suppressed by alternating-gradient focusing. In some cases, the conditions for stability require that ν/γ be small, which suggests that corrections to magnetohydrodynamics, associated with finite Larmor radii, are stabilizing. Calculations indicate that it should be possible to set up a stable toroidal relativistic self-focusing stream with major-to-minor-radius ratio of about 60. Alternating-gradient focusing, which may prove essential, would improve this figure; a surrounding conducting tube would not. (auth)

3767 (PWA-1940) MAGNETOHYDRODYNAMIC POWER GENERATOR FEASIBILITY STUDY. Final Engineering Report. (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Feb. 1961. Contract AF30(602)-2268. 238p. (RADC-TR-61-104; AD-257619)

An investigation was carried out to determine the feasibility of using magnetohydrodynamic (MHD) principles for the generation of 1000 Mw of electrical power for short periods of time with an operating lifetime of 20 hr. maximum. The generator was designed to produce the 1000 Mw in an MHD section 20 ft. long. Total generator length including exhaust ducts is less than 80 ft. The plasma is created by seeding the combustion products of a hydrocarbon fuel and oxygen with potassium nitrite. The magnetic field is produced by a copper-coil electromagnet which is cooled by liquid oxygen to reduce the electrical heating losses. The high voltage output for driving the RF tubes is obtained by a unique arrangement of interelectrode connection. The cost of a complete MHD generator system including a fuel tank-farm and liquid oxygen plant is estimated for planning purposes to be approximately $5 per kilowatt. This estimate does not include the costs of development, site preparation, transportation of materials, or the transportation and housing of personnel. (M.C.G.)

3768 (R61SD089) SHOCK WAVES IN A PLASMA. K. T. Yen (General Electric Co. Missile and Space Vehicle Dept., Philadelphia). June 1961. 17p. (AD-258032)

Presented at a colloquium of the Department of Aeronautical Engineering, University of Cincinnati, May 4, 1961.

Recent analytical work on shock waves (normal) in a fully-ionized plasma is reviewed. Emphasis is on the physical nature of the problem, such as the speed of sound, shock structure, and temperature equalization between the electrons and ions. Some special features of this problem and possible direction of further research are included. (auth)

3769 (WADD-TR-60-836) MAGNETIC DIFFUSION IN A SHOCK-PRODUCED PLASMA. Arthur T. Lewis (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Oct. 3, 1960. Contract AF33(616)-7624. 51p. (AD-258203)

The problem of a plasma, produced by a shock wave, moving along a cylindrical shock tube and encountering an inhomogeneous, axially symmetric magnetic field created by a circular coil concentric with the shock tube was considered. The output of a search coil was related to the magnetic Reynolds number of the flow, and the magnitude of the magnetic Reynolds number for which the magnetic field can begin to strongly affect the plasma flow was found. The behavior at the limits of very low and very high magnetic Reynolds numbers was calculated for the condition that the imposed magnetic field does not affect the plasma flow. The calculated behavior was then compared at the limits with measurements made with the use of a solid copper slug. It was found that a magnetic Reynolds number, R_m, greater than 60 is necessary to exclude a large fraction of the magnetic field from the interior of the conductor. Magnetic diffusion effects were not measurable until $R_m \approx 5$ is reached, and the exclusion of more than 90% of flux from the search coil did not occur until $R_m \gg 100$. Measurements made with plasmas indicated that an appreciable fraction of the magnetic field is excluded from the plasma at high shock velocities, which gives the conditions necessary for studying the effects of magnetic forces on the plasma flow. Comparison with the copper slug measurements showed that a magnetic Reynolds number of 20 was reached and allows the conductivity of the plasma to be calculated and compared with its theoretical values. (auth)

3770 (ZPh-096) THE MICROWAVE DIAGNOSIS OF A COLUMN OF IONIZED GAS. J. R. Barthel (Convair, San Diego, Calif.). May 1961. Contract DA-04-495-ORD-3112. 16p. (AD-257972)

The inverse scattering problem of deducing the structure of a column of ionized gas from its microwave scattering properties was solved for a homogeneous column and a column which is sufficiently dilute that the electrons may be assumed to be independent scatterers. Criteria are presented which may be applied to experimental data to determine which of the above models (if either) is applicable. (auth)

3771 INTERACTION OF CHARGED PARTICLE BEAMS WITH PLASMA. Ya. B. Fainberg. Atomnaya Energ., 11: 313-35(Oct. 1961). (In Russian)

Interaction of charged particles with plasma plays an important role in the various discharges in the experimental devices used for the study of controlled thermo-

nuclear reactions. This interaction must be known in order to solve the problems involving acceleration of particles, and generation and amplification of microradiowaves by the plasma. In spite of the apparent differences in the types of interaction, at the basis of the processes lies the Vavilov-Cherenkov effect, the anomalous and normal Doppler effect, and the polarization of the plasma by the movement of the charged particles. The instabilities due to these factors are tabulated. Instabilities may arise at relatively low electron velocities. The periods of confinement of the plasma are in many cases longer than the times of growth of the instability, indicating that not all the listed instabilities play equally important roles. In spite of relatively successful theoretical work and related experimental proof, not all the instabilities arising in discharge phenomena can be predicted. This is due to the fact that in most cases only the excitation spectra are known while the amplitude of the exciting wave remains undefined. With increasing amplitude many non-linear effects which weaken the instability increase also. Most of the instabilities predicted by the theory have been observed experimentally and the basic characteristics, such as conditions of excitation, growth increments, frequency spectrum, and relaxation length agree well with the theory but much work remains to be done. (TTT)

3772 MAGNETIC TRAPS WITH CUSPED FIELDS. S. Yu. Luk'yanov and I. M. Podgornyi. Atomnaya Energ., 11: 336-44(Oct. 1961). (In Russian)

The magnetic methods used for some time both in the Soviet Union and abroad were found to be unsatisfactory because of the difficulty of confining the charged particles. The behavior of plasma in a trap formed by 2 opposite coaxial coils is reviewed, establishing the correlation between the time of escape of the plasma from the trap and the dimensions of the system and the initial energy of the plasma. The life time of the plasma in the trap was found to be proportional to (dimension/magnetic field strength)$^{1/2}$, increasing slowly with the initial energy while remaining practically independent of the plasma temperature. No single type of injector can be considered as "ideal" for introducing the hottest possible plasma in an exceedingly short time period. In traps with cusped poles the plasma is concentrated in the central region of the trap, leaving it through an annular magnetic slit. The plasma density in the central region depends on the magnetic field strength, the operation of the injector and the geometry of the experiment. The efforts of the experimenters are currently directed toward obtaining plasmas with high density and temperature; this requires improvement in the injecting devices and changes in the geometry of the injectors and traps. (TTT)

3773 A STABILITY CRITERION FOR A RADIALLY CONSTRICTED GAS DISCHARGE BETWEEN ELECTRODES. P. W. Seymour (Australian National Univ., Canberra). Australian J. Phys., 14: 321-34(Sept. 1961).

The stability of a centrally constricted, highly ionized deuterium discharge between electrodes is considered. Initially, the normal mode and energy principles for the examination of plasma stability are reviewed and the results contrasted. Teller's powerful stability criterion is next obtained in a useful integral form by means of a thermodynamic analysis of interchange instability. This general geometrical result is then applied to the centrally constricted plasma between electrodes, and a sufficient stability criterion derived. For this type of system, initially stabilized by a strong, external guiding magnetic field, it is found that the onset of instability occurs for a discharge current $I_\xi^*(w_b) \sim 1.6\ \varphi_E/z_e$, where φ_E from the external solenoid is the total flux through any discharge equipotential surface, z_e is the discharge semi-length, and practical simplifying assumptions of high radial compression ratio ν and maximum discharge radius $\rho_1 \cong \frac{1}{5} z_e$ have been made. (auth)

3774 FEATURES OF THE ABSORPTION OF LIGHT IN A NON-HOMOGENEOUS PLASMA. N. G. Preobrazhenskii (Tomsk State Univ.). Doklady Akad. Nauk S.S.S.R., 140: 801-4(Oct. 1, 1961). (In Russian)

An attempt is made to obtain plots of the equivalent line width versus the optical density ("growth curves") in a non-homogeneous, absorbing plasma. The general solution can be written conveniently as follows: $y_q(x) = y_1(x)\ [1 - 0.01F\ (x, q, a)]$ where $y_1(x)$ represents the plot for a homogeneous plasma, F is a deviation function which is asymptotic at $x \to \infty$ for values of the Foigt parameter a other than zero, and n and q are parameters of the non-homogeneity of the plasma as used by Cowan and Bartels. Values of the deviation function $F_c\ (k_0 l; n, a)$ are calculated and tabulated for values of $k_0 l$ from 2 to 40, values of a from 0.01 to 2.0 and values of n of 1.5, 2 and ∞. The optical density of the plasma $k_0 l = 0.0944\ x$. In comparing the "growth curve" for a homogeneous plasma ($n = 1$) with that for a non-homogeneous plasma ($n = 3$), five regions can be distinguished: 1) the plasma is transparent ($k_0 l < 0.5$); 2) the slope of the "growth curve" decreases smoothly ($0.5 < k_0 l < 3.0$); 3) the slope is a minimum ($3.0 < k_0 l < 15.0$); 4) the slope is equal to 0.5 ($15 < k_0 l < 100$), and 5) the slope is greater than 0.5 ($k_0 l > 100$). The most interesting property of these generalized "growth curves" is the occurrence of an anomalous section where an increase in optical density is accompanied not by an increase but by a decrease in equivalent line width. This effect takes place the more readily, the higher the degree of non-homogeneity of the plasma. (TTT)

3775 QUANTAL STUDY OF DIFFUSION AND VISCOSITY CROSS SECTIONS FOR A SCREENED COULOMB POTENTIAL. M. R. C. McDowell (Georgia Inst. of Tech., Atlanta) and G. Peach. Phys. Fluids, 4: 1332-41(Nov. 1961).

Born's approximation and the Massey-Mohr approximation are used to obtain quantum-mechanical values of the diffusion and viscosity cross sections Q_D and Q_η for a screened Coulomb potential. The parameters are chosen to represent an ionized gas with $10^9 \leq n_e \leq 10^{18}$, n_e being the electron density, and $5 \times 10^3 \leq T_e \leq 10^7$°K, T_e being the temperature. The scattering phase shifts are also evaluated and compared with those obtained from direct numerical integration of the scattering equation. Born's approximation to the phase shift is used in a Faxén-Holtsmark type analysis to give more accurate values of the cross sections at low T_e and large n_e. The results are used to discuss the behavior of the electrical conductivity of a fully ionized gas. (auth)

3776 EFFECT OF NEUTRAL PARTICLES ON THE TRANSPORT PROPERTIES OF A PLASMA IN A UNIFORM MAGNETIC FIELD. James P. Wright (Univ. of Chicago). Phys. Fluids, 4: 1341-7(Nov. 1961).

The effect of neutral particles on viscosity, heat flow, current, and drift in an ionized plasma is derived. The effect of neutrons in a hydrogen plasma in a strong uniform magnetic field is calculated. The effect begins to be significant at a temperature of approximately 10 kev, depending on the values of other variables. (auth)

3777 ELECTROHYDRODYNAMIC AND MAGNETOHYDRODYNAMIC SURFACE WAVES AND INSTABILITIES.

James R. Melcher (Massachusetts Inst. of Tech., Cambridge). Phys. Fluids, 4: 1348-54(Nov. 1961).

Low-frequency dynamics of a plane fluid interface stressed by tangential or perpendicular electric or magnetic fields is studied emphasizing the duality of the magnetic and electric cases. Both configurations are shown to be controlled by an effective Alfvén velocity for the magnetic cases, and by an electrohydrodynamic dual to this velocity for the electric cases. A wavelength and threshold for instability are predicted for a surface stressed by a perpendicular field, and correlated with experimental results. This makes possible a critical experiment to determine the nature of interfacial electrostriction in dielectrics. A dielectric interface stressed by a tangential electric field supports incompressible electrohydrodynamic transverse waves that propagate along the lines of electric field intensity at a velocity strongly influenced by interfacial electrostriction. Experimental results indicate the existence of such waves. (auth)

3778 MAGNETOHYDRODYNAMIC CHANNEL FLOW UNDER TIME-DEPENDENT PRESSURE GRADIENT. J. T. Yen and C. C. Chang (Univ. of Minnesota, Minneapolis). Phys. Fluids, 4: 1355-61(Nov. 1961).

Hartmann's work on magnetohydrodynamic channel flow is extended to include the case with a time-dependent pressure gradient. Cases treated are: suddenly applied pressure gradients which are periodic in time, and pressure gradients which, with respect to time, are step and delta functions. The channel walls are assumed to be perfectly conductive. As a limiting case, the solution for hydrodynamic channel flow with a time-dependent pressure gradient is also given. The nature of viscous and magnetic drag on the wall is discussed. By use of the convolution integral and superposition principle, solutions can be obtained for any arbitrary time-dependent pressure gradient. Figures show the physical consequence of the solutions. (auth)

3779 COLLISIONLESS PLASMA SHOCK WAVES. Hideo Yoshihara (Convair, San Diego, Calif.). Phys. Fluids, 4: 1361-5(Nov. 1961).

A solution for the profile of a collisionless plasma shock wave in the absence of magnetic fields is determined using the nonlinear Vlasov equations. The uniform shock speed is taken to be much less than the electron thermal speed of the ambient plasma. Under these conditions a solution is found for a given Mach number of the shock only for a definite ratio of the electron to positive ion temperatures in the quiescent plasma. Profiles of the macroscopic state variables are calculated for a Mach number of $2^{1/2}$. (auth)

3780 VARIATIONAL PRINCIPLES IN PLASMA DYNAMICS. Chau-Hsing Su (Princeton Univ., N.J.). Phys. Fluids, 4: 1376-8(Nov. 1961).

A Lagrangian density is constructed for a multifluid system. Maxwell's equations and flow equations for inviscid, barotropic, and infinitely electrical conducting fluid are obtained from the Lagrangian density through the use of the well-known Lagrange-Euler equations. Flow equations for plasma consisting of electrons and ions are derived from the equations of different species. In this way, in addition to the usual equations of momentum and continuity, a generalized Ohm's law is also obtained. (auth)

3781 DAMPING OF PLASMA OSCILLATIONS IN THE LINEAR THEORY. John N. Hayes (Naval Research Lab., Washington, D. C.). Phys. Fluids, 4: 1387-92(Nov. 1961).

The problem of stable oscillations of an infinite plasma is re-examined from the standpoint of an integral equation for the electric potential in the plasma. The behavior of a plasma with a Lorentz distribution is solved completely. How one may compute, under suitable restriction, the initial velocity distribution is shown when the electric potential is specified for all time. An initial velocity distribution is then solved which yields an electric potential which is nonoscillatory in character and damps as a Gaussian distribution in time; the initial velocity distribution is proved to be an entire function in velocity space. Since this result is contrary to that of Landau, his method of determining the electric potential is re-examined. (auth)

3782 PLASMA MOTION IN A CURVED MAGNETIC FIELD. Harold P. Eubank and Thomas D. Wilkerson (Princeton Univ., N. J.). Phys. Fluids, 4: 1407-11(Nov. 1961). (MATT-88)

A parametric study is made of the transmission of a burst of plasma through a 90° sector of magnetic field. Polarization fields are inhibited during the early phase of plasma entry into the bend, allowing complete transmission of the fast part of the plasma (densities $\sim 10^{11}/cm^3$). As the input density exceeds that for which the polarization field is inhibited, drifts occur which rapidly reduce the plasma transmission to zero. This transition appears to depend only upon the input density and magnetic field of the bend. (auth)

3783 UNSTABLE CYCLOTRON OSCILLATIONS IN A CYLINDRICAL PLASMA SHELL. P. Burt and Edward G. Harris (Oak Ridge National Lab., Tenn. and Univ. of Tennessee, Knoxville). Phys. Fluids, 4: 1412-16(Nov. 1961).

Longitudinal oscillations of a finite, cylindrical shell of plasma in a uniform axial magnetic field are investigated. The ions are assumed to move initially in concentric Larmor orbits while the electrons are stationary. By neglecting random velocities, it is possible to obtain a dispersion relation for longitudinal (electrostatic) waves which is solved in the limit of short wavelength perturbations. The real parts of the frequencies of the disturbances are found to be integral multiples of the ion cyclotron frequency. Conditions for instability similar to those of the infinite plasma are also found which depend upon the thickness of the shell. (auth)

3784 HYDROMAGNETIC STABILITY OF TOROIDAL EQUILIBRIA WITH AN EXTERNALLY IMPOSED ROTATIONAL TRANSFORM. John L. Johnson and John M. Greene (Princeton Univ., N. J.). Phys. Fluids, 4: 1417-26(Nov. 1961).

An expansion technique is employed to study the stability condition for toroidal hydromagnetic configurations in which the curvature of the system, the rotational transform per unit length, and the pressure which is contained in the system can be treated as small. The most general condition which is necessary for stability with respect to localized perturbations is obtained as a ratio of two infinite determinants. (auth)

3785 APPROXIMATE ASYMPTOTIC SPEED DISTRIBUTION OF IONS IN A "LONG" MAGNETIC MIRROR SYSTEM. David J. BenDaniel (Univ. of California, Livermore and General Electric Research Lab., Schenectady, N. Y.). Phys. Fluids, 4: 1447-8(Nov. 1961).

The Rosenbluth, MacDonald, and Judd equation used for calculating the ion loss rates from a long magnetic mirror system is altered for obtaining an approximate asymptotic distribution of the ions. The equation is reduced by invoking the fact that the Rosenbluth potential is very nearly

isotropic when the asymptotic angular distribution is attained. The asymptotic speed forms obtained from these computations are graphically given for several mirror ratios. (N.W.R.)

3786 LOW-FREQUENCY OSCILLATIONS IN GAS DISCHARGES. Francis F. Chen (Princeton Univ., N. J.). Phys. Fluids, 4: 1448-9(Nov. 1961). (MATT-78)

The possibility that there may be a natural mechanism for generating very low-frequency oscillations near a sheath when the ion temperature is much lower than the electron temperature is discussed. This mechanism is the electron pressure, which causes the ions to stream into the last mean free path before the wall with a velocity equal to or greater than $V_s \equiv (kT_e/M)^{1/2}$, where M is the ion mass. The most serious objection to this proposed mechanism is that ion-neutral collisions would be expected to damp waves of frequencies below the collision frequency so that they cannot propagate from the cathode sheath. (N.W.R.)

3787 TRANSPORT EQUATIONS FOR PLASMAS IN STRONG EXTERNAL FIELDS. Emmanuel Meeron (Convair, San Diego, Calif.). Phys. Rev., 124: 308-10(Oct. 15, 1961).

In an intense field plasma particles are much more strongly coupled to the field to each other, the motion of each particle depending on the strength and direction of the field rather than on its individual interactions with other particles. Pair and higher correlations become unimportant, and singlet superposition for the n-particle distribution function provides an excellent approximation. The singlet distribution function is then given by a Vlasov-type transport equation. This conjecture is proven correct on expanding the reduced Liouville equation in powers of a dimensionless field parameter, $\lambda = e/E\alpha^2$ (with α interpreted as an average approach distance), which expresses the ratio of the intensity of interparticle interactions to that of particle-field interactions; singlet superposition is then exact through terms linear in λ. A general closed hierarchy valid through any given power of λ is derived: solution exact through λ^m retains correlations through order m. Thus we see that, as the field becomes weaker, successively higher order correlations become important. Examples of the range of validity of the new treatment are given, and the lack of justification for the use of Boltzmann or Fokker-Planck type equations for microwave plasma diagnostics is briefly discussed, considering the low intensity of microwave beams, and thus the probable importance of pair and higher correlations. (auth)

3788 INSTABILITY OF ANTIFERROMAGNETIC SCREW-TYPE STRUCTURE OF AN ELECTRON GAS. Akio Yoshimori (Ohio State Univ., Columbus). Phys. Rev., 124: 326-8(Oct. 15, 1961).

An analysis of antiferromagnetic screw-type structure in a three-dimensional electron gas is given, using a self-consistent field method. It is shown that a screw-type state appears to be always unstable. The expression for the susceptibility of an electron gas found by Wolff is also obtained with this method. (auth)

3789 TOWARD THE SOLUTION OF SOME BOUNDARY PROBLEMS IN MAGNETOHYDRODYNAMICS. A. B. Vatazhin. Priklad. Mat. i Mekhan., 25: 965-8(Sept.-Oct. 1961). (In Russian)

Problems concerning the flow of an electroconducting medium in a planar channel are examined for different boundary conditions in the presence of a magnetic field. Certain parts of the walls of the channel act as the electrodes while other parts of the wall act as insulators. The flow of a liquid, with a constant conductivity, through the channel is examined in the presence of a magnetic field of an arbitrary value in the direction of flow and zero in the other directions. The flow velocity is considered first to be known and then allowed to be arbitrary. Next the flow of a gas is considered in the presence of a constant magnetic field. It is found that the magnitude of the current increases with the size of the electrode dimensions and the conductivity and decreases with the increase of the external resistance. Finally the problem is examined for a constant gas flow throughout the channel in the presence of a magnetic field determined by an arbitrary function. (TTT)

3790 MAGNETIC SURFACES. L. V. Korablev, A. I. Morozov, and L. S. Solov'ev. Zhur. Tekh. Fiz., 31: 1153-63(Oct. 1961). (In Russian)

The effects of various stellarator field perturbations were investigated by developing general formulas for averaged magnetic surfaces. An equation for magnetic fields close to a given magnetic surface was derived. (tr-auth)

3791 MAGNETIC SURFACES OF TRIPLE-LAYER HELICAL MAGNETIC FIELD DISTURBED BY CRIMPED FIELD. I. M. Gel'fand, M. I. Graev, N. M. Zueva, A. I. Morozov, and L. S. Solov'ev. Zhur. Tekh. Fiz., 31: 1164-9(Oct. 1961). (In Russian)

The laminar triple-layer helical magnetic field is described in cylindrical coordinates by the scalar potential $\psi = H_0 z + h_3/\alpha\, I_3(3\alpha r) \sin 3(\varphi - \alpha z)$, where H_0 is the intensity of the "longitudinal" homogeneous field, h_3 is the amplitude of the helical magnetic field, I_3 is a third-order Bessel function, and $\alpha = 2\pi/L$ where L is the coil space forming the field. In practical applications to thermonuclear systems various perturbations are applied to the field. An attempt is made to determine, in general terms, the influence of a crimped field on magnetic surfaces of different h_0 and k. (R.V.J.)

3792 ON RADIATION OF ELECTRONS MOVING ALONG A SPIRAL IN MAGNETOACTIVE PLASMA. [PART] I. V. I. Pakhomov, V. F. Aleksin, and K. N. Stepanov (Khar'kov Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Tekh. Fiz., 31: 1170-84(Oct. 1961). (In Russian)

The energy losses of nonrelativistic electrons moving along a spiral in plasma are determined on the basis of kinetic theory. It is assumed that the mean thermal velocity of plasma electrons is considerably lower than that of light. General expressions are developed for electric and magnetic fields created by electrons in plasma. The expressions are used for calculating the intensity of radiation emitted by electrons in the fundamental (s = 1) and multiple (s = 2, 3, ...) harmonics. (R.V.J.)

3793 TURBULENT PARTICLE LOSS IN STRONG MAGNETIC FIELD DISCHARGE. B. B. Kadomtsev. Zhur. Tekh. Fiz., 31: 1209-19(Oct. 1961). (In Russian)

It is shown that in a strong magnetic field a discharge is unstable when the plasma conductivity changes in space. A turbulent convection leading to plasma cooling and particle losses at the walls is caused by this instability. The time of plasma confinement is evaluated by introducing the corresponding coefficient of turbulent diffusion. The results are in good agreement with stellarator measurements. (tr-auth)

3794 INVESTIGATIONS OF PINCH DYNAMICS IN MAGNETIC FIELD. V. A. Suprunenko, E. D. Volkov, N. I. Reva, E. A. Sukhomlin, P. Ya. Burchenko, and N. I. Rudnev (Khar'kov Inst. of Physics and Tech., Academy of Sciences,

Ukrainian SSR). Zhur. Tekh. Fiz., 31: 1246-7(Oct. 1961). (In Russian)

The development of m = 1 type instability is investigated by a system of nine magnetic probes placed in a discharge chamber. It is shown that the discharge oscillation amplitude increases along the chamber radius with an electric field voltage increase proportional to $\sqrt{E}$. The discharge motion acceleration is approximately identical in character. (tr-auth)

3795 HYDRODYNAMIC AND HYDROMAGNETIC STABILITY. S. Chandrasekhar. The International Series of Monographs on Physics. Oxford, Clarendon Press. £5. 5s and New York, Oxford University Press, 1961. 672p. $16.80.

Thermal instabilities (i.e., instabilities caused by adverse temperature gradients) are studied in fluid spheres and spherical shells, and in the Benard problem concerning fluids heated from below. Attention is also given to instabilities caused by adverse angular momentum gradients, such as are encountered in Couette flow and more general flows between coaxial cylinders. Instabilities arising when two fluids are superposed are examined, with particular attention to the Rayleigh-Taylor and Kelvin-Helmholtz instabilities. Study is also devoted to gravitational and capillary instabilities of jets and cylinders; gravitational equilibrium and instability; and the derivation of a general variational principle. The hydrodynamic and hydromagnetic solutions of each of the types of flows considered are studied in juxtaposition, so as to demonstrate the effects of the magnetic field. (T.F.H.)

3796 IMPROVEMENTS IN OR RELATING TO PLASMA CONFINING DEVICES. (to Compagnie Generale de Telegraphie). British Patent 883,707. Dec. 6, 1961.

A plasma confining device is designed which uses a ring-shaped evacuated vessel as the container. A magnetic field is established in this vessel with regions of constriction "throats" of magnetic bottles, and a pattern of transverse hydromagnetic waves is set up in the plasma with their antinodes located in the areas of the regions of constriction. In this way, the sealing at the "throats" is improved and movement of plasma within each magnetic bottle is reduced. (D.L.C.)

3797 HIGH TEMPERATURE REACTOR. R. M. Kulsrud and L. Spitzer, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,012,955. Dec. 12, 1961.

An apparatus of the stellarator type for heating a plasma to high temperatures is designed. Circularizers at the end of the helical windings produce a circular magnetic surface and provide improved confining and heating of the plasma. Reverse curvature sections formed in the end loops of the reaction tube provide increased plasma pressure for a given magnetic field pressure and thereby minimize the current flow in the helical windings. (AEC)

3798 PLASMA DEVICE. James D. Gow and John M. Wilcox (to U. S. Atomic Energy Commission). U. S. Patent 3,014,857. Dec. 26, 1961.

A device is designed for producing and confining high-energy plasma from which neutrons are generated in copious quantities. A rotating sheath of electrons is established in a radial electric field and axial magnetic field produced within the device. The electron sheath serves as a strong ionizing medium to gas introduced thereto and also functions as an extremely effective heating mechanism to the resulting plasma. In addition, improved confinement of the plasma is obtained by ring magnetic mirror fields produced at the ends of the device. Such ring mirror fields are defined by the magnetic field lines at the ends of the device diverging radially outward from the axis of the device and thereafter converging at spatial annular surfaces disposed concentrically thereabout. (AEC)

Shielding

Refer also to abstracts 3132, 3140, 3153, 3154, 3155, 3156, and 3876

3799 (NDL-TR-6) ATTENUATION OF SIMULATED FALLOUT RADIATION BY THE ROOF OF A CONCRETE BLOCKHOUSE. Murray A. Schmoke and Ralph E. Rexroad (Army Chemical Corps Nuclear Defense Lab., Army Chemical Center; Md.). Aug. 1961. 80p.

An experiment was carried out to verify theoretical calculations of the effect of roof thickness on the radiation level inside a concrete blockhouse from a plane of gamma radiation on the roof. (auth)

3800 ATTENUATION OF THE NEUTRON FLUX IN THE CONCRETE SHIELD OF THE SYNCHROCYCLOTRON. M. M. Komochkov. Atomnaya Energ., 11: 399-401(Oct. 1961). (In Russian)

The half-value thickness $\Delta_{1/2}$ of the neutron-absorbing layer must be known in order to calculate the dimensions of the shield against radiations originating in an accelerator. This parameter is well known for low neutron energies, less well studied at energies up to 300 Mev and is completely unknown at still higher energy levels. The problem was studied at the Joint Institute of Nuclear Research, using a cylindrical opening in the 2-meter thick concrete wall of the synchrocyclotron. Neutron detectors were placed at various distances, filling the volume between them with concrete stoppers. The data indicated the presence of two separate groups of neutrons in the beam with $\Delta_{1/2}$ values of 6 to 9 and 41 to 43 cm which correspond to neutrons with energies of several and of several hundreds of Mev, respectively. An equilibrium is established between the 2 neutron groups after passage through 90 cm of concrete. The results agree with calculations based on the assumption that in the attenuation of neutrons their inelastic interaction with the nuclei is of paramount importance. (TTT)

Theoretical Physics

3801 (NYO-9535) SOME BORCHERS—TYPE THEOREMS IN QUANTUM FIELD THEORY. R. Acharya (Rochester, N. Y. Univ.). Nov. 8, 1961. Contract AT(30-1)-875. 10p.

Several simple theorems of the Borchers type are proved for a class of fields satisfying $[A(x), B(y)] = F(x-y)$, where $F(x-y)$ vanishes for space-like separations but is not in general a c-number. The proofs are based on appropriate use of the Jacobi identity and are valid even when some of the postulates generally accepted for quantum field theories are relaxed. (auth)

3802 THEORY OF BOUND-STATE BETA DECAY. John N. Bahcall (Indiana Univ., Bloomington). Phys. Rev., 124: 495-9(Oct. 15, 1961).

The theory of beta-decay processes in which an electron is created in a bound atomic state is developed in the allowed approximation. The correlations and total decay rate are calculated with the renormalized V–A theory and the results are valid for atoms of arbitrary electronic configuration. The relative probability of bound-state to continuum-state decay is shown to be independent of nuclear matrix

elements; some bound-state decay rates are presented that were calculated by making use of this fact. The possibility of experimentally detecting bound-state decay is also briefly examined. The beta decay of nuclei in stellar interiors is discussed and a number of examples are presented for which bound-state decay is more likely than continuum-state decay under the conditions that obtain in stellar interiors. (auth)

3803 CLASSICAL THEORY OF RADIATION SOLUTIONS FOR THE COULOMB FIELD. P. A. Clavier (Ford Motor Co., Newport Beach, Calif.). Phys. Rev., 124: 616-21(Oct. 15, 1961).

Eliezer has contended that the Dirac equations for the motion of a particle in a Coulomb field, when the radiative reaction is included, do not have physically realizable solutions. The problem is reinvestigated and Eliezer's conclusion proved false. Two-dimensional solutions (spirals) are found, which can be described with the exclusive use of integrable functions. One-dimensional solutions (radial trajectories) are found for both a repulsive and an attractive pole. The radial solutions involve distributions (in the sense of Schwartz). A consequence of the solutions is the emission of a strong pulse of radiation when a particle hits an attractive pole or when it leaves a repulsive one. (auth)

3804 CHARGED BOSON GAS. Leslie L. Foldy (Case Inst. of Tech., Cleveland). Phys. Rev., 124: 649-51(Nov. 1, 1961).

The ground state energy and elementary excitations of a charged gas of bosons at high densities are examined by use of the method developed by Bogoliubov for boson gases. It is conjectured, but not established, that this method yields exact results in the high-density limit analogous to those obtained in the corresponding case of a charged fermion gas. The ground state energy is essentially correlation energy, and is therefore negative, and its magnitude varies as the one-fourth power of the density at high densities. The elementary excitations have for low momenta the energy appropriate to plasma waves, and for high momenta the energy appropriate to single-particle excitation. There is therefore an energy gap, suggesting that the gas is both a superfluid and a superconductor at low temperatures. At low densities the behavior of a charged gas is independent of statistics; hence, such a gap must disappear as the system is expanded. (auth)

3805 APPLICATION OF THE PADÉ APPROXIMANT METHOD TO THE INVESTIGATION OF SOME MAGNETIC PROPERTIES OF THE ISING MODEL. George A. Baker, Jr. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 124: 768-74(Nov. 1, 1961).

On the basis of the Padé approximant method it is deduced from the exact series expansions for the Ising model that the reduced magnetic susceptibility behaves at the critical point as $\chi_{fcc} \approx [0.09923/(0.101767 - \omega)]^{5/4}$, $\chi_{bcc} \approx [0.152773/(0.1561789 - \omega)]^{5/4}$, $\chi_{sc} \approx [0.22138/(0.218156 - \omega)]^{5/4}$, $\chi_t \approx [0.2432/(2 - \sqrt{3} - \omega)]^{5/4}$, $\chi_{sq} \approx [0.35724/(\sqrt{2} - 1 - \omega)]^{5/4}$, and $\chi_h \approx [0.4506/(1/\sqrt{3} - \omega)]^{5/4}$, where $\omega = \tanh(J/kT)$ and the last figure quoted is somewhat uncertain. The spontaneous magnetization is found to behave as $(I_0/I_\infty)_{fcc} \approx [12.5(0.664658 - z^2)]^{0.3}$, $(I_0/I_\infty)_{bcc} \approx [10.4(0.5326607 - z^2)]^{0.3}$, and $(I_0/I_\infty)_{sc} \approx [10.9(0.411940 - z^2)]^{0.3}$, where $z = \exp(-2J/kT)$ and again the last place quoted is somewhat uncertain. The numbers $^5/_4$ and $^7/_4$ have an error of at most 10^{-3}, and 0.3 of at most 10^{-2}. The lattices referred to are fcc, face-centered cubic; bcc, body-centered cubic, sc, simple cubic; t, triangular; sq, simple quadratic; and h, honeycomb. (auth)

3806 ANALYSIS OF THE STATISTICAL DENSITY MATRIX. K. M. King and L. H. Thomas (Columbia Univ., New York). Phys. Rev., 124: 785-92(Nov. 1, 1961).

A generalized expression for the statistical field is obtained, which includes the Thomas-Fermi (TF) and Thomas-Fermi-Dirac (TFD) fields as special cases. The behavior of the energy, charge density, boundary density, and electron groups is investigated for various fields. Fields with exchange are obtained that behave like the TF field at the boundary. A singularity in the TFD density matrix is found, which leads to an oscillation in the sign of the charge in high angular momentum states. This singularity is related to the necessity for terminating the TFD distribution at a finite boundary. Comparison of the Fourier components and wave functions calculated from statistical density matrices for Cu^+ with the corresponding Hartree-Fock values reveals that it is not useful to use the statistical density matrix as a starting point for a Hartree-Fock calculation. (auth)

3807 VIRIAL THEOREM FOR MANY-ELECTRON DIRAC SYSTEMS. John N. Bahcall (Indiana Univ., Bloomington). Phys. Rev., 124: 923-4(Nov. 1, 1961).

The virial theorem is derived for a system of N relativistic electrons interacting with each other via electrostatic forces and subject to arbitrary external electromagnetic fields. The results are presented in a form that can be used in perturbation calculations and investigations of nonisotropic systems. The equation of state for a system of N electrons confined to a box is discussed on the basis of the virial theorem. (auth)

3808 MACH'S PRINCIPLE AND A RELATIVISTIC THEORY OF GRAVITATION. C. Brans and R. H. Dicke (Princeton Univ., N. J.). Phys. Rev., 124: 925-35(Nov. 1, 1961). (PUC-1961-39)

The role of Mach's principle in physics is discussed in relation to the equivalence principle. The difficulties encountered in attempting to incorporate Mach's principle into general relativity are discussed. A modified relativistic theory of gravitation, apparently compatible with Mach's principle, is developed. (auth)

3809 MANDELSTAM REPRESENTATION FOR DIRAC POTENTIAL SCATTERING. K. W. Edwards (Princeton Univ., N. J.). Phys. Rev., 124: 936-9(Nov. 1, 1961).

The scattering amplitude for Dirac potential scattering is shown to have a Mandelstam representation if the potential is a superposition of Yukawa potentials. This representation, together with the unitarity condition, is used to obtain an integral equation for the weight functions. The subtraction in energy makes it necessary to know the scattering amplitude's dependence on momentum transfer at zero energy in order to solve for the weight functions. Dispersion relations for the partial wave amplitudes are obtained. (auth)

3810 ELECTROMAGNETIC POTENTIALS IN QUANTUM MECHANICS. Henri E. Mitler (Brandeis Univ., Waltham, Mass.). Phys. Rev., 124: 940-4(Nov. 1, 1961).

Electromagnetic potentials are found to be significant in quantum theory, even when the fluctuations of the vacuum are taken into account. Conditions are found under which the fluctuations will, nevertheless, wash out an interference pattern. (auth)

REACTOR TECHNOLOGY

General and Miscellaneous

3811 (AD-257585) NEUTRON FLUX MAPPING OF A SUBCRITICAL REACTOR CORE WITH A POLYETHYLENE REFELCTOR (thesis). Kenneth Leon Gilbert (Texas. Univ., Austin). May 1961. 67p.

The neutron distribution of The University of Texas subcritical reactor is described by a two-group, three-region diffusion approximation in which the fluxes can be expanded in an infinite series of eigenfunctions, W_ν, with corresponding eigenvalues, B_ν, which form a complete orthogonal set. The diffusion equations expressed in cylindrical geometry were expanded to four terms and a computer solution was obtained for the resulting eighth-order matrix. The resulting curves for the axial and radial neutron distributions from the core at midplane show that the four-term expansion was completely inadequate to obtain sufficient convergence to the experimental curve. Recommendations are given for the simplification of the diffusion equations by an approximation in spherical geometry, and for the expansion to be carried out to eight terms for an eighth-order matrix. (B.O.G.)

3812 (ANL-6248(Add.)) TERMINAL REPORT ON THE BOILING SLURRY REACTOR EXPERIMENT (SLURREX). (Mockup Hydraulic Experiments). Joseph D. Lokay (Argonne National Lab., Ill.). Oct. 1961. Contract W-31-109-eng-38. 33p.

A half-scale mockup was built to study the hydraulics of the proposed SLURREX reactor system. Analysis of the pressure drop written as the summation of the frictional, acceleration, and hydrostatic head components around the closed flow loop yielded a hydraulic equation from which the circulation velocity can be computed ($307\alpha = 3.44\ V_D^2/2g$). Experimental results gave a velocity head coefficient of 3.20 as compared with the estimated value of 3.44. Static pressure taps were located at various points to check individual flow losses. The results indicated that most of the individual losses were overestimated, so that the higher velocity head coefficient was found. (auth)

3813 (ANL-6403) FAST REACTOR SHAPE FACTORS AND SHAPE-DEPENDENT VARIABLES. W. B. Loewenstein and G. W. Main (Argonne National Lab., Ill.). Nov. 1961. Contract W-31-109-eng-38. 29p.

Existing experimental data on the variation of reactivity with core geometry are reviewed. Four typical fast neutron systems are analyzed to predict: (1) the variation of critical mass with cylindrical core geometry (core and reflector composition are held fixed); (2) the reactivity worth of fuel at the radial core boundary as a function of cylindrical core geometry; and (3) the geometric variation of heat removal parameters; these include the ratio of: (a) Maximum power density to average power density in the core. (b) Maximum power density to average radial power density in the core. (c) Total reflector power to total core power. The absolute values of all of these parameters are determined by the core and reflector compositions of the four systems. These were chosen to simulate typical constituents of interest to reactor analysis. Two systems represent a typical fast reactor and a typical fast critical experiment. The other two systems represent compositional combinations of the two basic systems. The results of the analyses show that the significant geometric variation is in items (2) and (3b). Item (1) is almost constant for small variations near the optimum geometric configuration. Outside of this range, the variation of critical mass with core geometry is pronounced. A most significant result shows that the ratio of the spherical critical mass to the minimum cylindrical critical mass (shape factor), for fixed core and reflector composition, depends primarily on core composition. The composition of the thick reflector has a lesser effect on this ratio which was found to increase with core density. The two-dimensional calculations are interpreted and analyzed on the basis of one-dimensional concepts. Reflector savings are calculated for spherical and cylindrical systems. The more exact reflector savings determinations are compared with more approximate calculations. It is found that the approximate determinations are qualitatively correct and show correct trends. However, the more detailed and accurate analytical techniques are required for precision comparison between theory and experiment. An interesting correlation between critical mass and core surface area is demonstrated. It was found that, in the range of interest, the critical mass depends almost linearly upon the surface area. The same linear dependence approximates all the systems studied. (auth)

3814 (ATL-A-121) DEVELOPMENT OF CLAD CERAMIC FUEL PLATES BY SPRAY-COATING TECHNIQUES. Quarterly Technical Progress Report, April–June 1961. N. E. Weare, E. Buchanan, and H. Marchandise (Advanced Technology Labs. Div. of American-Standard, Mountain View, Calif.). Contract AT(04-3)-250. 26p.

Studies were made on the effects of spray-coating variables on coating characteristics in the development of plasma-jet spraying techniques for making clad UO_2 fuel plates. UO_2 coatings of up to 90% theoretical density and O/U ratios of nearly 2.00 were deposited at efficiencies of 40%. Adherent UO_2 coatings up to 0.100 inch thick can be deposited on 0.030-inch thick stainless steel and Zircaloy-2 substrates. Studies of coated composite bends and coating adherence at room temperature indicate that, for best results, the coating temperature should be maintained below 870°C and the substrate below 450°C during deposition. A plasma spray torch was tested for spraying UO_2 at 40 kw and found to be equivalent to operation at 25 kw. A preliminary cost analysis indicated considerably lower fabrication costs using plasma jet spraying: ~$100/kg U as compared to ~$150/kg U for oxide pellet-in-tube elements. (D.L.C.)

3815 (BMI-X-182) ON ANALYSIS OF COOLANT CONTAMINATION PROBLEMS IN GAS-COOLED REACTORS. C. Townley, R. Wooton, and J. C. Smith (Battelle Memorial Inst., Columbus, Ohio). Feb. 10, 1961. Contract [W-7405-eng-92]. 21p.

An analysis was made of the problems of shielding, radiological hazards, and emergency maintenance of equipment associated with a reactor primary coolant system containing fission products. The results indicate a maximum permissible concentration of 5×10^{-7} curies/cc of coolant in a typical gas-cooled power reactor produces a 7.5 mr/hr radiation field at the heat exchanger for 1 ft of concrete shielding. This condition overshadows the other problems considered, which were emergency maintenance operations after one day of cooling, leakage into the containment vessel, and losses through a stack. (B.O.G.)

3816 (CEA-1858) ETUDE DE CIRCUITS DE COMMUTATION DESTINES A LA SECURITE DES REACTEURS NUCLEAIRES (THESE). (A Study of Switch Circuits for Use as Safety Devices in Nuclear Reactors (thesis)). Vartan Hantcherian (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 83p.

Submitted to Univ. of Paris.

A few basic assemblies using electromagnetic relays for safety circuits in nuclear reactors are reviewed briefly, and the use of static relays with a shorter time of response, based on impedance changes in a self-inductance consisting of a coil with a magnetic core having a rectangular hysteresis cycle, is studied. The way in which it functions and the method of determining the parameters is examined in particular. (auth)

3817 (CRFD-1011) POST IRRADIATION EXAMINATION OF SEVEN ELEMENT ZIRCALOY-SHEATHED UO_2 FUEL BUNDLES IRRADIATED IN PRESSURIZED WATER; TEST CR-V-e. A. S. Bain, R. D. MacDonald, and J. A. L. Robertson (Atomic Energy of Canada Ltd., Chalk River, Ont.). Aug. 1961. 34p. (EXP-NRX-1104; AECl-1320)

Zircaloy-2 sheathed UO_2 pellets, enriched to 7.95 wt % U^{235} in total U, and assembled into seven-rod clusters, were irradiated for 145 days in a pressurized water loop. The most highly rated element operated at 505 W/cm length, and achieved a burn-up in excess of 7,500 MWd/ton of U. The outer elements of each bundle had bowed outward by a maximum of 0.05 in., but there was no measurable change in diameter of the individual elements. The temperatures at the center of the fuel were sufficiently high to cause appreciable grain growth in the UO_2. Severe distortion of the neutron flux distribution by the highly enriched fuel caused the grain growth region to be displaced toward the outside of the bundle by about $\frac{1}{4}$ of the element's radius. The bowing of the elements was attributed to the thermal asymmetry. The values of the fuel burn-up deduced from loop calorimetry were in agreement, within experimental error, with those obtained by chemical analysis; the heat rating required to produce grain growth was compatible with previous experience. This irradiation confirmed the feasibility of using highly rated UO_2 in Zircaloy sheathing for fuel assemblies in water-cooled reactors. (auth)

3818 (GA-2385) THE EXPERIMENTAL BERYLLIUM OXIDE REACTOR. MARITIME GAS-COOLED REACTOR PROGRAM. W. C. Moore (General Atomic Div. General Dynamics Corp., San Diego, Calif.). July 1961. Contract AT(04-3)-187. 29p.

The Experimental Beryllium Oxide Reactor, EBOR, will be constructed at the National Reactor Testing Station as the AEC portion of the joint Maritime Administration–AEC Maritime Gas Cooled Reactor Program. The ultimate goal of the Program is the development of nuclear power plants employing a helium cooled and beryllium oxide moderated reactor directly coupled to a closed cycle gas turbine. The objective is to obtain compact nuclear engines suitable for use either in a merchant ship propulsion system or an intermediate size central station power plant in the 20 to 100 Mw(e) size range. The EBOR is a 10 Mw(t) test of the basic fuel element and moderator designs. It is capable of being up-graded in power at a later date to a test of the nuclear reactor turbine concept. The objective of the experiment is outlined. The principal reactor components to be tested and the test facility are described. (auth)

3819 (GEAP-3739) PLASTIC STRAIN IN THIN FUEL ELEMENT CLADDING DUE TO UO_2 THERMAL EXPANSION. M. F. Lyons, F. A. Comprelli, V. E. Hazel, and H. E. Townsend (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). July 7, 1961. Contract AT(04-3)-189. 94p.

Results are presented of short time, high heat flux capsule irradiations to determine the magnitude of plastic strain induced in the capsule cladding due to UO_2 thermal expansion. Annular geometry capsules were employed with both internal and external cladding and forced convection cooling of both surfaces to simulate the reference superheat fuel element design. Both 304 stainless steel and 3003 aluminum claddings of various thickness were used to determine the influence of cladding strength. The initial gap spacing was purposely varied as an additional parameter. The program was undertaken as a part of the effort to evaluate plastic strain cycling as life limitation in the use of thin fuel element cladding. An over-all summary of the experimental results is included. (auth)

3820 (GEAP-3764) DETERMINATION OF LIFETIME OF THE B_4C-IN-TUBES CONTROL ROD. F. H. Megerth (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). July 19, 1961. Contract AT(04-3)-189. 22p.

The lifetime of a "B_4C-in-tubes" control rod may be limited by either nuclear worth depreciation or internal gas pressure buildup as helium is formed and released from the B_4C particles. Nuclear life is enhanced by thin tube walls for any given O.D. of tubing and by high B_4C density, but the time to failure from gas pressure buildup is increased by the opposite. The optimum B_4C density and tube wall thickness were calculated for maximum control rod life, using several release fractions of generated helium and a number of allowable cladding stress values. It was estimated that lifetimes of 10 or more years for B_4C-in-tubes control systems are achievable through the proper selection of tubing material and B_4C density values. The B_4C densities required for maximum lifetimes are in a range that can be obtained by vibratory compaction followed by swaging. (auth)

3821 (HW-52347) PRPR GAMMA RAY AND NEUTRON HEAT GENERATION CALCULATIONS. J. R. Triplett (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 21, 1957. Contract AT(45-1)-1350. 19p.

Calculations are presented for the heat generated by gammas and neutrons at various points in the Plutonium Recycle Test Reactor as a guide to preliminary design studies. (D.L.C.)

3822 (HW-61989) EXPERIMENTAL PROGRAM FOR THE PRTR GAS LOOP. D. E. Baker (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 1, 1959. Contract AT(45-1)-1350. 8p.

The PRTR Gas Loop is an in-reactor pressurized gas loop which will be installed in the Plutonium Recycle Test Reactor for studying the reactions of graphite and other reactor materials with gases under irradiation conditions. A description is given of one year's experimental program for the gas loop, which consists mainly of studies of the CO_2–graphite reaction. (D.L.C.)

3823 (HW-64561) HEAT TRANSFER CALCULATIONS FOR THE PRTR PRESSURIZED GAS-COOLED LOOP FACILITY. J. Muraoka (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1961. Contract AT(45-1)-1350. 74p.

A series of calculations are described which evaluated the heat transfer and fluid flow aspects of the Plutonium

Recycle Test Reactor Pressurized Gas-Cooled Loop Facility. These calculations investigated areas where detailed design was completed and verification of its adequacy was desired. In addition, calculations were performed to allow certain design areas to proceed. Both steady-state and/or transient type calculations were made in these principal areas: (1) primary-loop pressure drop; (2) total energy balance; (3) maximum rate of temperature change in the primary piping; (4) shroud-tube cooling system; (5) loss of primary and/or shroud coolants; (6) emergency back-up cooling systems. (auth)

3824 (HW-68183) REACTOR SAFETY REVIEW. G. C. Fullmer and R. W. Reid (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 17 1961. Contract W-31-109-Eng-52. 22p.

A review is given of the shutdown margins, operation of reactor control systems, and administrative controls in use at all reactors operated by the Hanford Atomic Products Operation. The discussion for each reactor includes: a description of the reactor; a discussion of reactor physics, control systems, and nuclear instrumentation as they relate to operating and shutdown control adequacy; and a review for each reactor of the administrative controls utilized to insure that control systems function as required and that operating and maintenance activities are conducted within reactor safety requirements. (N.W.R.)

3825 (HW-68198) DR-1 LOOP. AN IN-REACTOR GAS-COOLED TEST FACILITY. F. W. Van Wormer (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 17, 1961. Contract AT(45-1)-1350. 23p.

The DR-1 loop, now being used to test fuel elements and materials in support of the Maritime Gas-Cooled Reactor (MGCR) program, is discussed in detail. The components and the coolant flow path in the loop are described. The operation of the loop with two MGCR fuel element prototypes is described briefly. (D.L.C.)

3826 (HW-70453) AN EDDY CURRENT TECHNIQUE FOR MEASURING THE PROCESS-TP-SHROUD TUBE ANNULUS IN THE PRTR. J. C. Spanner (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 1961. Contract AT(45-1)-1350. 18p.

Development is reported of an in-reactor technique for measuring the relative annular spacing between the reactor fuel channels and the Al shroud tubes which surround them. The spacing measurement is based on the principle that when the position of a current-conducting material is varied with respect to a stationary inductive coil excited with an alternating current, the eddy-currents induced in the material vary the effective impedance of the coil. (J.R.D.)

3827 (IDO-16029) REACTIVITY PERTURBATIONS DUE TO LOCALIZED ABSORBERS IN THE MTR. H. L. McMurry (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Sept. 16, 1952. Contract AT(10-1)-205. 4p.

Derivation of a simple formula is reported for calculation of the effect on ($\Delta k\infty/k\infty$) in MTR of local absorbers in cases where these absorbers are not black to neutrons. (J.R.D.)

3828 (IDO-16607) ENGINEERING TEST REACTOR CRITICAL FACILITY CONTROL SYSTEM MANUAL. F. A. Meichle (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). June 23, 1961. Contract AT (10-1)-205. 103p.

A manual is presented which gives a description, drawings, connections, and schematics of the various control elements making up the control system of ETRC, a swimming-pool full-scale mock-up of the core and reflector of the ETR. The manual is to serve as an instruction manual for new ETRC operating personnel and as a maintenance manual for the control system. (D.L.C.)

3829 (IDO-16712) MTR SHIM ROD CALIBRATIONS. A. W. Brown (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Sept. 19, 1961. Contract AT(10-1)-205. 34p.

The data from six Materials Testing Reactor shim rod calibrations were compiled and reduced to values of excess reactivity versus average shim rod position. The reduced data have a spread of about 20%. A curve fitted to the most recent data was used to construct a nomograph for computing the excess reactivity associated with any given change in shim rod position. (auth)

3830 (IDO-16721) SPERT III REACTOR FACILITY. R. E. Heffner and T. R. Wilson (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Oct. 25, 1961. Contract AT(10-1)-205. 124p.

The Special Power Excursion Reactor Test III (Spert III) reactor is a pressurized-water nuclear-research reactor which was constructed to provide a facility for conducting reactor kinetic behavior and safety investigations. The investigations are designed to provide information for the advancement of pressurized-water and boiling-water reactor technology and safety. The facility was designed for operations up to pressures of 2500 psig and temperatures of 670°F and incorporates essential features typical of pressurized-water and boiling-water reactors. The engineering features of the reactor and supporting process equipment as constructed at the National Reactor Testing Station are described. (auth)

3831 (IDO-16722) THE MERITS OF INHERENT SHUTDOWN VS MECHANICAL SHUTDOWN OF A PLATE-TYPE, WATER-MODERATED AND -REFLECTED REACTOR IN A RUNAWAY CONDITION. F. L. Bentzen (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Nov. 3, 1961. Contract AT(10-1)-205. 13p.

Based on a paper presented at the 1960 Winter Meeting of the American Nuclear Society, San Francisco, California, December 12-15, 1960.

A small stainless-steel, plate-type, water-moderated reactor is subjected to large reactivity insertions in a study of the effectiveness of a fast safety system as compared with the self-shutdown characteristics of the reactor. The effectiveness of the mechanical safety system in controlling a reactor in a runaway condition is shown to be adequately described by the postulation of an effective delay time, which can be considered to be constant for all periods. The delay is comprised of the electronic release time and the time required for the rods to reach an effective position in the core. In the system tested, the short effective delay time of 30 msec prevents reactor damage to periods as short as a few milliseconds. It is also shown that for safety systems with longer effective delay times, the ability of the reactor to cope with large reactivity insertions is determined by the inherent shutdown characteristics of the reactor and not by the mechanical system. (auth)

3832 (IDO-19301) SL-1 RECOVERY OPERATIONS, JANUARY 3–MAY 20, 1961. (Combustion Engineering, Inc. Nuclear Div., Idaho Falls, Idaho). June 20, 1961. Decl. Nov. 6, 1961. Contract AT(10-1)-967. 322p. (CEND-1007)

Plans for deactivation of the SL-1 facility, which underwent a nuclear excursion on Jan. 3, 1961, are discussed, along with results of radiation surveys of the facility area.

The condition of the reactor is described in detail. Plans for injecting a boric acid solution into the core are disclosed; subsequently, it was decided to leave the core dry and to decontaminate and disassemble the reactor. All involved equipment are described. (D.L.C.)

3833 (MND-E-2418) LABORATORY SIMULATION OF PM-1 CORE THERMAL AND HYDRAULIC TRANSIENT CONDITIONS. ANPP Nucleate Boiling Program. Final Report. J. J. Jicha, R. Lightner, R. Magladry, and M. P. Norin (Martin Co. Nuclear Div., Baltimore). Oct. 1961. Contract DA-44-192-ENG-6. 195p.

A loss of flow incident was simulated for the PM-1 to establish the safety of the core thermal design. Power excursions were also simulated to establish fuel element integrity, and the transients required to produce fuel element burnout were determined. Other information from the transient study is included. (J.R.D.)

3834 (NDL-TR-12) NEUTRON FLUX MEASUREMENTS OF THE TRIGA MARK F REACTOR. John H. McNeilly and John W. Kinch (Army Chemical Corps Nuclear Defense Lab., Army Chemical Center, Md.). Sept. 1961. 36p.

The neutron environment of the Triga Mark F Reactor was determined by using the neutron threshold detector system. A total of 107 measurements was made resulting in 562 separate neutron flux determinations. The results of the measurements and a description of the experimental procedure are given. An appendix is also included that presents neutron flux data obtained from the Triga Mark I Reactor during April 1959 and on 12 October 1960. (auth)

3835 (NMI-1246) WOUND AND FOLDED SINGLE-SHEET FUEL ELEMENTS. Final Technical Report, July 1, 1960–June 30, 1961. R. G. Jenkins, E. F. Jordan, A. R. Gilman, and J. M. Siergiej (Nuclear Metals, Inc., Concord, Mass.). Aug. 25, 1961. Contract AT(30-1)-1565. 80p.

Model nuclear reactor fuel subassemblies were produced from single clad fuel plates rather than from many individual fuel tubes, plates or pins. The coolant channel spacings of the models are maintained by projections rising from non-fuel areas dispersed throughout the core region. A preliminary cost study indicated that subassemblies produced from a single fuel element generally have a cost advantage over those produced from numbers of pins, plates, or tubes. (auth)

3836 (ORNL-3193) NEUTRON PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 1, 1961. (Oak Ridge National Lab., Tenn.). Nov. 17, 1961. Contract W-7405-eng-26. 368p.

Fifty-seven papers and 17 abstracts of papers are presented in the report. Fifty two of the papers are abstracted separately; in addition, a single abstract is written to cover the section on Plasma Physics Theory, which contains 3 papers and 8 abstracts of papers. The two brief papers not abstracted separately are concerned with fast neutron detection, and homogeneous critical assemblies of 3%-enriched UF_4-paraffin systems. (T.F.H.)

3837 (ORNL-3193(p.3-4)) THE REACTIVITY EFFECT OF AN AIR-FILLED CAVITY WITHIN A POOL CRITICAL ASSEMBLY CORE. E. B. Johnson (Oak Ridge National Lab., Tenn.).

It is shown experimentally that a positive void coefficient of reactivity exists in the core center-line of the Pool Critical Assembly. The assembly is fueled with BSR-I fuel elements, and the void is introduced in a Lucite container in order to keep the metal/water ratio constant. (T.F.H.)

3838 (ORNL-3193(p.4-9)) CENTER LINE ATTENUATION MEASUREMENTS OF RADIATION FROM A BERYLLIUM-REFLECTED POOL CRITICAL ASSEMBLY. E. B. Johnson (Oak Ridge National Lab., Tenn.).

The attenuation of thermal neutrons and γ radiation from the Pool Critical Assembly by successive thicknesses of water, Be, and Fe is measured. The fuel and reflector geometry is as close as possible to that proposed for HFIR. (T.F.H.)

3839 (ORNL-3193(p.9-21)) TOWER SHIELDING REACTOR II OPERATION AND CALIBRATION. L. B. Holland, V. R. Cain, et al. (Oak Ridge National Lab., Tenn.).

The Tower Shielding Reactor II (TSR-II), including control systems and cooling systems, is operated at powers to 100 kw (thermal) on a 24 hr per day basis. The reactor is used with no shield external to the pressure vessel, with an asymmetric shield, and with two nesting, lead-water shields designed to provide spectrum changes. During the operation of the reactor, power linearity is improved, a comparison technique is developed to measure absolute reactor power, and studies leading to improved coolant circulation are carried out. (T.F.H.)

3840 (ORNL-3193(p.22-5)) IN-AIR MEASUREMENTS OF RADIATION FROM THE TOWER SHIELDING REACTOR II (TSR-II). F. J. Muckenthaler and L. B. Holland (Oak Ridge National Lab., Tenn.).

The γ and neutron dose rates from TSR-II are measured as a function of reactor height and reactor-detector range from 0 to 3500 ft. The measurements are taken using a shield designated as Cool-I. (T.F.H.)

3841 (ORNL-3193(p.29-44)) THE FITTING OF INTERPOLATION FUNCTIONS TO SCINTILLATION SPRECTOMETER PULSE-HEIGHT SPECTRA. R. W. Peelle, R. O. Chester, and F. C. Maienschein (Oak Ridge National Lab., Tenn.).

A method is presented for interpreting γ spectra from the responses of Compton, pair, and single-crystal spectrometers. The method consists of interpolating between pulse-height spectra of various monoenergetic sources, using a nonlinear least squares technique, in order to find a set of parameters describing the spectrometer response. A valid error matrix may be found. The method is demonstrated for Na^{24}. (T.F.H.)

3842 (ORNL-3193(p.44-52)) UNSCRAMBLING OF SCINTILLATION SPECTRA. W. R. Burrus (Oak Ridge National Lab., Tenn.).

A statistical method is developed for estimating solutions to the integral equations encountered in scintillation spectrometry. The method consists in expressing the quantity for which an estimate is desired in terms of a window function, and, by proper choice of the window function, estimating a partially unscrambled spectrum with some residual smearing or some linear function of the spectrum. Estimates of the actual spectrum are generally unattainable. The method gives conservative results, and cannot give negative values. (T.F.H.)

3843 (ORNL-3193(p.52-5)) EXPERIMENTAL DETERMINATION OF FLUX DEPRESSION AND OTHER CORRECTIONS FOR GOLD FOILS EXPOSED IN WATER. W. Zobel (Oak Ridge National Lab., Tenn.).

The neutron flux depression caused by the presence of an Au foil of thickness 0 to 500 mg/cm^2 is measured in light water, and compared with theoretical predictions. The

saturated activity of the foils is also measured as a function of thickness. (T.F.H.)

3844 (ORNL-3193(p.55-8)) THE MODEL IV GAMMA-RAY SPECTROMETER: STATUS REPORT. G. T. Chapman and K. M. Henry (Oak Ridge National Lab., Tenn.).

The long-term performance characteristics of a 9-in.-diameter × 12 in.-long NaI(Tl) crystal γ spectrometer are discussed. The background at 4 to 300 Mev is shown to be probably caused by cosmic ray interactions with the spectrometer shield. The background below 4 is assumed to be caused by long-lived radionuclides naturally present in the shield. (T.F.H.)

3845 (ORNL-3193(p.58-62)) SOLID-STATE FISSION DETECTORS. T. A. Love and K. M. Henry (Oak Ridge National Lab., Tenn.).

The use of Si–Au surface barrier diodes having U^{235} film coverings as fission detectors is studied. Techniques for achieving stable operation at exposures up to 10^{12} neutrons are described. Recovery of the diodes after irradiation, and the effects of temperature on recovery, are studied. The causes for instabilities at high exposures are investigated. (T.F.H.)

3846 (ORNL-3193(p.63-74)) STUDIES OF THE SCINTILLATION PROCESS IN CsI(Tl). R. Gwin and R. B. Murray (Oak Ridge National Lab., Tenn.).

A phenomenological theory of the scintillation process in thallium-activated alkali iodides, based on a description of energy transport from the incident charged particle to the luminescence centers is considered. This model leads to several specific predictions of the behavior of scintillation efficiency as a function of thallium concentration of the crystal and as a function of the specific energy loss of the incident particle. These predictions are subjected to experimental investigation as a test of the validity of the proposed model. The experimental program described encompasses a study of the scintillation response of several CsI(Tl) crystals of varying thallium content to monoenergetic gamma rays and protons, with attention to effects dependent upon the scintillation-pulse clipping time. (T.F.H.)

3847 (ORNL-3193(p.74-8)) EFFECT OF DELTA RAYS ON RESPONSE OF INORGANIC SCINTILLATORS TO HEAVY IONS. A. Meyer and R. B. Murray (Oak Ridge National Lab., Tenn.).

The scintillation efficiency (dL/dE or ϵ) of Tl-activated alkali iodides to heavy ions is studied, as a function of the ion's specific energy loss (dE/dx). It is found that a single curve of ϵ vs. dE/dx is inadequate; ϵ must be represented as a family of curves, one for each ion. A model is presented, in which it is proposed that the varying ϵ for each ion is caused by the fact that delta ray (high energy electron) production by these ions increases with energy, and that these delta rays have a high ϵ. Using NaI(Tl), ϵ is measured for He^4, B^{10}, C^{12}, N^{14}, O^{16}, F^{19}, and Ne^{20}, and the results are compared with the model's predictions. (T.F.H.)

3848 (ORNL-3193(p.78-94)) THERMAL-NEUTRON DENSITY PERTURBATIONS BY FOILS IN WATER. S. A. Hasnain, T. Mustafa, and T. V. Blosser (Oak Ridge National Lab., Tenn.).

The perturbation of an almost purely thermal, nearly isotropic neutron flux by foils of Au, In, Cu, and 93.18-wt %-U^{235} U is studied in light water. The flux perturbation factors are found as functions of foil thicknesses, from 0.2 to 1600 mg/cm^2. (T.F.H.)

3849 (ORNL-3193(p.95-9)) DETERMINATION OF URANIUM CONTENT IN FOILS BY MEASURING INTENSITY OF NATURAL RADIATIONS. S. A. Hasnain, T. Mustafa, and T. V. Blosser (Oak Ridge National Lab., Tenn.).

The measurement of the intensity of the natural x and gamma radiations emitted by a sample of uranium provides a quick, accurate, and nondestructive method of measuring the uranium content of small specimens. A procedure is developed by which such measurements can be made with high accuracy for foils, very thin films, or solutions of uranium. The method is tested with various samples of known composition. (T.F.H.)

3850 (ORNL-3193(p.100-2)) NEUTRON DISTRIBUTION IN A REACTOR FUEL PLATE. S. A. Hasnain and E. B. Johnson (Oak Ridge National Lab., Tenn.).

The neutron flux distribution in a BSR-type fuel plate and in the water near the plate is measured, in the Pool Critical Assembly by activation methods. The plate is composed of a 20-mil-thick, 93.18-wt %-U^{235}-enriched U foil, sandwiched between two 20-mil-thick Al foils. (T.F.H.)

3851 (ORNL-3193(p.102-9)) CALIBRATION OF A BF_3 PROPORTIONAL COUNTER IN WATER AND IN AIR. Tariq Mustafa and T. V. Blosser (Oak Ridge National Lab., Tenn.).

The absolute calibration of a 96% B^{10}-enriched BF_3 counter by comparison with foil activation measurements is described. The counter is calibrated in air and water, in the thermal column of the ORNL Graphite Reactor. Differences in the counter responses in air and water are attributed to differences in the flux perturbations caused by the counter in the two media. (T.F.H.)

3852 (ORNL-3193(p.110-15)) DEVELOPMENT OF A LOW-LEVEL GAMMA-RAY DOSIMETER USING AN ANTHRACENE CRYSTAL. T. Mustafa and T. V. Blosser (Oak Ridge National Lab., Tenn.).

A dosimeter is developed for γ dose rates of 0.02 to 100 mrad/hr and for γ energies of 0.1 to 5 Mev. The region of equivalence of the tissue dose and the anthracene crystal dose is determined. The sensitivity of the dosimeter to neutrons is only about 2%. The construction and calibration of the dosimeter are described; the dosimeter is accurate to within ±20%. (T.F.H.)

3853 (ORNL-3193(p.116-19)) FAST-NEUTRON SPECTROSCOPY WITH SILICON SURFACE-BARRIER COUNTERS. T. A. Love and K. M. Henry (Oak Ridge National Lab., Tenn.).

A 3 to 15 Mev neutron detector is discussed that consists of a layer of Li^6F between two Si–Au surface barrier detectors. Neutrons are detected by the reaction $Li^6(n,\alpha)T$. The effects of γ and neutron backgrounds on the count rates are discussed. The efficiency of the detector varies between 0.3 and 0.6%, depending on the beam-detector alignment. (T.F.H.)

3854 (ORNL-3139(p.119-23)) THE DISTRIBUTION IN ENERGY OF ALPHA-TRITON PAIRS RESULTING FROM NEUTRON BOMBARDMENT OF LITHIUM FLUORIDE. F. S. Alsmiller (Oak Ridge National Lab., Tenn.).

A surface barrier fast neutron detector is considered that is composed of a Si–Au–Li^6F–Au–Si sandwich. The neutrons are detected when an α and a T from the reaction $Li^6(n,\alpha)T$ enter opposite Si layers. A formula is given for N(W) as a function of the neutron energy and angle of incidence, where N(W) is the probability that an α-T pair will be detected with total energy W. (T.F.H.)

3855 (ORNL-3139(p.123-8)) DETERMINATION OF SELF-SHIELDING FACTOR BY USING MULTIPLE STACKED FOILS. S. A. Hasnain, T. Mustafa, and T. V. Blosser (Oak Ridge National Lab., Tenn.).

Gold and indium foils are stacked to total thicknesses of 9 to 22 mils, and exposed in air and water to thermal neutrons. The shielding effects of the outer foils on the inner foils are measured by activation methods; thus the self-shielding factors of the foils may be found. (T.F.H.)

3856 (ORNL-3139(p.131-2)) CRITICAL PARAMETERS OF SOLUTIONS OF U^{235}-ENRICHED URANYL NITRATE IN CYLINDRICAL CONTAINERS. J. K. Fox (Oak Ridge National Lab., Tenn.).

The critical dimensions of cylindrical Al vessels containing enriched solutions of $UO_2(NO_3)_2$ are determined. At 93.15 wt % U^{235}, the solvent is a D_2O-H_2O mixture containing 70.1 wt % D_2O. At 92.6 wt % U^{235}, the solvent is H_2O. The cylinder diameters vary from 24 to 51 cm, and the critical heights from 19 to 72 cm. The data are taken for unreflected, B–D_2O-reflected, and H_2O-reflected cylinders. (T.F.H.)

3857 (ORNL-3193(p.133-6)) NUCLEAR SAFETY TESTS OF THE HIGH FLUX ISOTOPE REACTOR FUEL ELEMENT. J. K. Fox (Oak Ridge National Lab., Tenn.).

The nuclear safety parameters of a fuel element to be used in HFIR Critical Experiment No. 2 are studied. The element consists of a central void ("target region"), an inner annulus having 171 fuel plates, and an outer annulus having 369 fuel plates. The criticality of the outer annulus alone and of the assembled element is determined, under conditions of complete water flooding of the target region, and of partial water flooding of the target region with various void distributions. (T.F.H.)

3858 (ORNL-3193(p.135-58)) HIGH FLUX ISOTOPE REACTOR CRITICAL EXPERIMENT NO. 2. D. W. Magnuson (Oak Ridge National Lab., Tenn.).

The assembly for HFIR Critical Experiment No. 2 consists of mockups of the fuel element, central target region, side Be reflector, top and bottom water reflectors, control plates, beam tubes, and a nuclear target. The fuel element consists of a central target region and two concentric annular fuel regions. Measurements are made of the control-plate operation characteristics; temperature, void, and fuel coefficients of reactivity; and flux and power distributions. (T.F.H.)

3859 (ORNL-3193(p.159-67)) CRITICAL ARRAYS OF NEUTRON-INTERACTING UNITS. L. W. Gilley, D. F. Cronin, et al. (Oak Ridge National Lab., Tenn.).

Critical experiments are performed with solutions of 92.6 wt % U^{235}-enriched $UO_2(NO_3)_2$ in water, at an average concentration of 410 g of U per liter. The solution containers consist of two types of polyethylene bottles, having nominal volumes of 13 and 15 liters, respectively, and aluminum cylinders. The variables studied are volume content of the container, surface-to-surface spacing between containers, and the geometric pattern (square, linear, or triangular) within an array of containers. Other experiments evaluate effects of moderation and partial reflection or simulated environmental conditions of interest to nuclear safety. (auth)

3860 (ORNL-3193(p.168-73)) NEW CRITICAL EXPERIMENT MACHINES. E. R. Rohrer, W. C. Tunnell, and D. W. Magnuson (Oak Ridge National Lab., Tenn.).

Two critical-experiment machines are described that utilize the split-table technique for combining subcritical amounts of solid fissionable material into critical assemblies. One machine, with a capacity of 500 lb, operates in a vertical plane; the other, with a 2000 lb capacity, operates in a horizontal plane. The safety mechanisms and scram characteristics of the two devices are described. (T.F.H.)

3861 (ORNL-3193(p.173-4)) EQUIPMENT FOR TIME-DEPENDENT NEUTRON STUDIES AT THE CRITICAL EXPERIMENT FACILITY. D. W. Magnuson and J. T. Mihalczo (Oak Ridge National Lab., Tenn.).

A 150-kv positive-ion accelerator is described that is used to produce 14 Mev neutrons by the $T(d,n)He^4$ reaction for use in time-dependent neutron studies. Burst widths of 1 to 10^4 μsec, with repetition rates of from 10 to 10^5 cycles/sec, are available with one method of operation, while a second method produces neutron bursts as short as 0.7 and 0.06 μsec. Background is less than 0.0001 of the rate when the beam is on target. (auth)

3862 (ORNL-3193(p.177-87)) THE MEASUREMENT OF α AS A FUNCTION OF ENERGY. G. deSaussure, L. W. Weston, et al. (Oak Ridge National Lab., Tenn.).

Experiments leading toward a precise measurement of α, the capture cross section to fission cross section ratio, as a function of neutron energy are completed. Determinations of α are discussed at 30 and 65 kev, and over the range from 1 ev to 150 kev for the principal fissionable isotopes. A fission chamber is designed and tested, and various problems involving background radiation and counting techniques are investigated. Electronic circuitry is also designed, built, and tested. (auth)

3863 (ORNL-3193(p.187-8)) SELECTION OF A LIQUID ORGANIC SCINTILLATOR FOR AN EXPERIMENTAL DETERMINATION OF α. L. Weston, W. S. Lyon, and J. D. Kington (Oak Ridge National Lab., Tenn.).

Eleven organic scintillator solutions were tested by comparing relative pulse-height response to the 1.1 Mev gamma ray from Zn^{65}. The solution that appeared most promising for use in the experiments to measure α, the neutron capture/fission cross section ratio, was triple-distilled xylene containing 4.0 g of p-terphenyl per liter, 0.3 g of POPOP per liter, 1 wt % gadolinium 2-ethyl hexoate, and 1 vol % ethyl alcohol. (auth)

3864 (ORNL-3193(p.189-91)) FISSION GAMMA-RAY ENERGY RELEASE AS A FUNCTION OF TIME AFTER FISSION. F. C. Maienschein (Oak Ridge National Lab., Tenn.).

Existing experimental and calculated fission gamma-ray energy release data are summarized and plotted as fission gamma-ray release per unit time, integrated over gamma-ray energy, as a function of time after fission. (auth)

3865 (ORNL-3193(p.191-7)) USE OF 4π HIGH-PRESSURE IONIZATION CHAMBERS AS SECONDARY STANDARDS FOR CALIBRATION OF GAMMA-RAY SOURCES. R. W. Peelle (Oak Ridge National Lab., Tenn.).

The efficiencies of Compton and pair spectrometers used in measurements of the spectrum of prompt gamma rays from U^{235} fission are to be determined by the use of known-strength radioactive sources. The strengths of these sources are determined by measurement of two 4π high-pressure ionization chambers. Calibration of the absolute efficiencies of these chambers is performed in a manner that permits detailed estimates of precision to be assigned. (auth)

3866 (ORNL-3193(p.197-9)) COLLIMATOR OPTIMIZATION FOR REACTOR GAMMA-RAY SPECTRA MEASUREMENTS. G. T. Chapman (Oak Ridge National Lab., Tenn.).

A long, thin core of BSR-1 fuel elements is used to evaluate the influence of collimator design on gamma-ray spectra measured by the BSF Model IV spectrometer. A satisfactory optimization appears to be a relatively long lead collimator preceded by a 2- to 5-ft-long air-filled aluminum cone. With this arrangement the spectrometer

can be successfully used at distances as short as 140 cm from the reactor. The cone is designed to include only the collimator solid angle. (auth)

3867 (ORNL-3193(p.203)) AN EXPERIMENTAL DETERMINATION OF THE AGE OF U^{233} FISSION NEUTRONS IN WATER. T. V. Blosser and D. K. Trubey (Oak Ridge National Lab., Tenn.).

The age to indium resonance energy (1.45 ev) of U^{233} fission neutrons in water is experimentally determined. Methods and procedures follow those of U^{235} measurements. A preliminary value of the age, in which only geometric corrections are applied, is 26.4 cm^2. (auth)

3868 (ORNL-3193(p.204-15)) CALCULATION OF THE TRANSMISSION FUNCTION FOR A NEUTRON CHOPPER. V. V. Verbinski and J. D. Jarrard (Oak Ridge National Lab., Tenn.).

Equations are developed to describe the average transmission per burst and the pulse shape of a burst of neutrons for a neutron chopper consisting of a rotating wheel with slits. An IBM-7090 computer program is written to solve the equations numerically. The method is applicable to any slit shape that can be described in piecewise segments by simple mathematical expressions. A comparison with an analytic calculation for a special case shows agreement to better than ±0.1%. (auth)

3869 (ORNL-3193(p.215-22)) PULSED-NEUTRON MEASUREMENTS IN BERYLLIUM. E. G. Silver and G. deSaussure (Oak Ridge National Lab., Tenn.).

An attempt is made to measure neutron diffusion parameters in beryllium, in temperature regions between 25 and −100°C, in order to verify theoretical calculations predicting large changes in this region. It is found that unexpected effects retard establishment of an equilibrium spectrum, thus changing the neutron decay from a single exponential to a decay with continuously changing slope. This situation prohibits an assignment of unambiguous values to diffusion parameters. Improvements to the time base analyzer used permit the determination of very accurate values for room-temperature constants. (auth)

3870 (ORNL-3193(p.223-8)) A NOTE ON MEASUREMENTS OF DIFFUSION PARAMETERS BY THE PULSED-NEUTRON SOURCE TECHNIQUE. G. deSaussure (Oak Ridge National Lab., Tenn.).

A possible cause of the discrepancies between various measurements of the neutron diffusion cooling constant by the pulsed-neutron technique is presented. The diffusion cooling constant must be determined from the measurement of the asymptotic decay constant of the neutron population in small moderating assemblies. It is shown that under certain conditions this asymptotic decay constant may not be measurable. The effect is investigated in some detail for the case of beryllium. (auth)

3871 (ORNL-3193(p.228-33)) AN APPLICATION OF PILE NOISE ANALYSIS TO MEASUREMENTS OF KINETIC PARAMETERS OF A POOL-TYPE REACTOR. M. N. Alam, A. Colomb, and K. M. Henry (Oak Ridge National Lab., Tenn.).

An experiment to measure reactor kinetic parameters such as neutron generation time, temperature and void coefficients, etc. in a pool-type research reactor is discussed. The plan is to utilize the random neutron density fluctuations within the core as reactivity input signals and from them to deduce the reactor transfer function. Assembly, construction, and test of apparatus are essentially completed. No data are taken. (auth)

3872 (ORNL-3193(p.237-50)) A NONLOCAL POTENTIAL MODEL FOR THE SCATTERING OF NEUTRONS BY NUCLEI. F. G. J. Perey and B. Buck (Oak Ridge National Lab., Tenn.).

An energy-independent nonlocal optical potential model for the elastic scattering of neutrons from nuclei is proposed and solved numerically in its full integro-differential form. The parameters of the potential, obtained solely from the fitting of the experimental differential cross sections for lead at 7 and 14.5 Mev, are used unchanged to calculate the elastic differential cross sections, total and reaction cross sections, and polarizations on elements from aluminum to lead at energies from 0.4 to 24 Mev. The same parameters are used to calculate the S-wave strength function and the effective scattering radius R'. In the usual notation the parameters are real potential V, 71 Mev; r, 1.22 fermi; a, 0.65 fermi; surface imaginary potential W, 15 Mev; a, 0.47 fermi; nonlocality β, 0.85 fermi; spin-orbit potential, using the nucleon mass in the Thomas form, U_{so}, 1300 Mev. Calculations are compared to experiment over the whole energy range. (auth)

3873 (ORNL-3193(p.250-3)) AN AUTOMATIC PARAMETER SEARCH CODE FOR NUCLEAR REACTION CALCULATIONS. F. G. J. Perey and B. Buck (Oak Ridge National Lab., Tenn.).

A flexible, automatic parameter search code is written for the IBM-7090 computer, which automatically adjusts any combination of up to 15 parameters simultaneously to achieve the best agreement, in the least-squares sense, with the experimental data. (auth)

3874 (ORNL-3193(p.245-8)) THE CALCULATION OF INELASTIC SCATTERING CROSS SECTIONS. B. Buck (Oak Ridge National Lab., Tenn.).

The distorted-wave Born approximation, a direct interaction theory approach, gives a good account of many inelastic reactions but breaks down when the interaction strength is not small. A strong-coupling theory is therefore examined, by construction of a pilot calculation to investigate the strong coupling of two nuclear levels, specifically a ground state 0^+ and a first excited state 2^+. Coded for the IBM-7090 computer, the calculation gives the total absorption cross section, the total inelastic cross section, and the elastic and inelastic differential cross sections. If the incident particles are neutrons, the total nuclear and total elastic cross sections are also obtained. (auth)

3875 (ORNL-3193(p.258-60)) THE TDC PERTURBATION CODE. W. E. Kinney and G. E. Whitesides (Oak Ridge National Lab., Tenn.).

A FORTRAN code is written to compute material replacement coefficients of reactivity and neutron lifetimes by perturbation theory. Fluxes from TDC, a two-dimensional, cylindrical (r,z) geometry, transport theory code, are used. The equation for the fractional change in the multiplication constant is given; input parameters are detailed; and available output options are noted. Finally, a graphical comparison of code results with experiment is shown, and a neutron lifetime computed by the code is compared with an experimentally determined lifetime in a similar but not identical fast assembly. (auth)

3876 (ORNL-3193(p.265-78)) ENERGY AND ANGULAR DISTRIBUTIONS OF NEUTRONS PENETRATING SLABS OF DIFFUSING MEDIA. PART I. ENERGY SPECTRA. V. V. Verbinski (Oak Ridge National Lab., Tenn.).

Measurements of the spectra of neutrons through a medium of lithium hydride include the following: leakage spectra from a slab of the material as a function of slab thickness and angle of escape; scalar flux spectra within the slab as a function of position; and spectra of the

forward-directed component of neutron flux from the bottom of a re-entrant hole as a function of the material thickness. The energy range is from about 0.01 ev to several hundred ev. The experimental energy spectra in general agree with NIOBE and O5R code calculations. Both the experiments and the calculations show that the neutron flux attains low-energy spectral equilibrium in a poisoned, hydrogenous medium after remarkably small penetration depths. In addition to the direct comparison of the calculations and experiments, the flux gradients from the NIOBE calculations are used to relate the neutron flux leaking from a re-entrant hole in lithium hydride to the scalar flux at the bottom of the hole. (auth)

3877 (ORNL-3193(p.278-87)) ENERGY AND ANGULAR DISTRIBUTIONS OF NEUTRONS PENETRATING SLABS OF DIFFUSING MEDIA. PART II. ANGULAR DISTRIBUTIONS. V.V. Verbinski (Oak Ridge National Lab., Tenn.).

Angular distributions of low-energy neutrons emerging from slabs are measured for the following media: a non-slowing-down medium without capture (lead); a non-slowing-down medium with capture (lead poisoned with B_4C); a slowing-down medium with weak capture (water); a slowing-down medium with intermediate capture (boric acid solution); and slowing-down media with strong capture (methyl borate + methanol, and lithium hydride). Both measurements and calculations indicate that the emergent angular distributions of low-energy neutrons attain equilibrium after a few centimeters of penetration for a hydrogenous medium with intermediate or strong capture. (auth)

3878 (ORNL-3193(p.288-94)) MONTE CARLO CALCULATION OF NEUTRON REFLECTION FROM WATER. D. K. Trubey (Oak Ridge National Lab., Tenn.).

Neutron histories generated by the O5R code are processed to yield values of both the number and the energy reflection coefficients (albedos) for a 10-in.-dia. monoenergetic beam of neutrons incident on a 42-in.-dia., 6-ft-long cylinder of water. Five source energies from 0.5 to 8 Mev are considered, and calculations are made both by statistical estimation and by analog methods. The results show agreement with calculations utilizing similar assumptions concerning cross sections. (auth)

3879 (ORNL-3193(p.295-9)) THE CONDITIONAL MONTE CARLO METHOD APPLIED TO NEUTRON SCATTERING IN AIR. W. E. Kinney and R. R. Coveyou (Oak Ridge National Lab., Tenn.).

The applicability of the conditional Monte Carlo method to the calculation of neutron scattering in air is evaluated by comparison with analog Monte Carlo method, age theory, and moments method calculations. Three forms of the function $f_\mu(\rho)$, which appears in the weighting factor for the conditional method, are tried—a collision age form, a group age form, and an exponential form. Computations of collision density as a function of radius by the various methods show a general failure of the conditional Monte Carlo method as higher orders of collision are approached. Analog Monte Carlo results, on the other hand, appear to agree with moments method calculations to distances of ~8 mean free paths, and age theory results become valid after about 12 collisions. (auth)

3880 (ORNL-3193(p.299-304)) MOMENTS METHOD AND NIOBE CALCULATIONS OF NEUTRON PENETRATION IN Be, BeO, LiH, AND OTHER MATERIALS. H. Goldstein (Nuclear Development Corp. of America, White Plains, N. Y.).

A study of neutron penetration in various reactor and shield materials is carried out. The program consists of extensive Renupak (moments method) and NIOBE code calculations for Be, BeO, and LiH some additional calculations for D_2O, Fe, H_2O, and C. In addition, a few computations are carried out for specific shield configurations. Preliminary results indicate that the data on Be and BeO, which include information on ages, fast effects, flux spectra, and neutron dose, will provide a definitive picture of the neutron penetration in these materials. The calculated ages for Be and BeO are 69 and 89 cm^2, respectively. (auth)

3881 (ORNL-3193(p.304-10)) A RECALCULATION OF THE GAMMA-RAY ENERGY SPECTRUM OF THE BULK SHIELDING REACTOR I. G. T. Chapman (Oak Ridge National Lab., Tenn.).

Capture gamma-ray data and a complete prompt-fission gamma-ray spectrum are utilized to calculate the gamma spectrum of the BSR-1. The results of the calculation show disagreement with experimental measurements. (auth)

3882 (ORNL-3193(p.310-14)) EXPERIMENTAL VERIFICATION OF A GEOMETRICAL SHIELDING TRANSFORMATION. L. Jung, F. J. Muckenthaler, et al. (Oak Ridge National Lab., Tenn.).

The geometrical transformation enabling dose rate due to a large disk to be inferred from data obtained with a smaller disk is experimentally tested. Thermal-neutron fluxes from source disks with diameters of 7, 9.33, 14, and 19.80 in., which are simulated by cadmium placed adjacent to a 28-in.-dia. source plate, are measured and compared to predictions based on standard transformations. (auth)

3883 (ORNL-3193(p.314-18)) THE DIFFERENTIAL ENERGY AND ANGULAR SPECTRA OF NEUTRONS FROM A POINT ISOTROPIC SOURCE IN INFINITE GEOMETRY. H. E. Stern, R. E. Maerker, and D. K. Trubey (Oak Ridge National Lab., Tenn.).

The Monte Carlo technique of statistical estimation is applied to the calculation of differential energy and angular spectra, angular collided dose rates, and total dose rates from a point isotropic 8 Mev source of neutrons in an infinite medium of hydrogen of density 0.111 g/cm^3. A comparison of the results with moments method data shows agreement for source-detector separation distances of up to 60 cm. (auth)

3884 (ORNL-3193(p.318-19)) DESIGN OF A WINDOW FOR A HOT CELL. J. M. Miller and F. J. Muckenthaler (Oak Ridge National Lab., Tenn.).

Preliminary experiments leading to the design of a hot cell window were completed. Neutron removal cross sections were measured for two commercial glasses and compared to calculations based on analyses of the glasses. The commercial glasses were mocked up with ordinary plate glass and lead slabs to give an equivalent neutron removal cross section, and these mockups were then used in various configurations with water in order to optimize the design of the window. Oil will be used instead of water in the actual window. A full-scale mockup of the design resulting from the preliminary experiments was tested. (auth)

3885 (ORNL-3193(p.323-4)) INTRANUCLEAR CASCADE CALCULATION. H. Bertini (Oak Ridge National Lab., Tenn.).

A Monte Carlo program intended to calculate the types, energies, and direction cosines of the cascade particles resulting from the interactions of high-energy particles incident on complex nuclei is discussed. A sampling technique is devised that eliminates a need for using estimated average cross sections. Some preliminary results, encompassing incident proton energies of 82 to 426 Mev, are compared with experimental data. (auth)

3886 (ORNL-3193(p.325-9)) EXPERIMENTAL SPACE VEHICLE SHIELDING PROGRAM. W. A. Gibson, W. R. Burrus, and T. A. Love (Oak Ridge National Lab., Tenn.).

An experimental program is initiated to study the secondary particles emerging from shields bombarded by high-energy protons from cyclotrons. Intensity, angular distribution, and spectral measurements are to be undertaken on the secondary neutrons, protons, and gamma rays. Dosimeter measurements are also to be made. The instrumentation for the neutron measurements is discussed. In order to cover the energy range from 50 to 700 Mev, cyclotrons at different laboratories are to be used. (auth)

3887 (ORNL-3193(p.329-39)) ELECTRON-PHOTON CASCADE SHOWERS. C. D. Zerby and H. S. Moran (Oak Ridge National Lab., Tenn.).

A general-purpose electron-photon cascade calculation, using the Monte Carlo technique, is programmed for the IBM-7090 computer. The calculation is designed to investigate cascade showers in the energy range from 6.5 Mev to 50 Bev, and yields information on track length, flux, probability of finding n particles at various depths, and energy deposition. Data on copper, water, iron, and lead are obtained. (auth)

3888 (ORNL-3193(p.339-41)) TRANSVERSE SHIELDING CALCULATION FOR A 45-Bev ELECTRON ACCELERATOR. R. G. Alsmiller, Jr., and F. S. Alsmiller (Oak Ridge National Lab., Tenn.).

An approximate cascade calculation was carried out to provide a check on estimates of the thickness of earth shielding required for the accelerator tube of the proposed 45-Bev Stanford electron accelerator. A straight forward approximation results in a set of coupled integrodifferential transport equations that give the neutron, proton, charged pion, and muon fluxes as functions of energy and distance. Because of the limited experimental information available concerning high-energy interactions, major reliance is placed upon cosmic-ray data. An IBM-7090 code was written to solve the transport equations numerically. The equations and the code are not uniquely restricted to the Stanford problem, and are expected to be of value in the solution of other high-energy shielding problems. (auth)

3889 (ORNL-3193(p.343-51)) PLASMA PHYSICS THEORY. Y. Shima, W. E. Kinney, et al. (Oak Ridge National Lab., Tenn.).

Two brief reports are presented, in which are studied the total cross section for dissociation of the H_2^+ ion by collisions with electrons and protons, and the Mode I-Mode II plasma instability. Abstracts of 9 papers are also included. (T.F.H.)

3890 (ORNL-3218) POSTIRRADIATION EXAMINATION OF 17-4 PH STAINLESS STEEL CONTROL ROD DRIVE RACK FROM SM-1 REACTOR. K. K. Klindt, A. E. Richt, and W. C. Thurber (Oak Ridge National Lab., Tenn.). Dec. 1, 1961. Contract W-7405-eng-26. 28p.

A portion of the control rod drive system in the SM-1 Reactor, fabricated from 17-4 PH stainless steel, was examined at the Oak Ridge National Laboratory (ORNL) hot cells after successful operation in a pressurized-water environment for approximately three years. Examination included visual inspection, magnetic-particle tests, fluorescent penetrant tests, and metallography. No evidence of stress-corrosion cracking or other damage was noted. (auth)

3891 (ORNL-TM-52) HYDRODYNAMIC TESTS OF CYLINDRICAL HRE-2 REPLACEMENT CORE MODEL. W. R. Mixon and C. G. Lawson (Oak Ridge National Lab., Tenn.). Sept. 26, 1961. Contract [W-7405-Eng-26]. 26p.

Fluid flow properties of a one-fifth scale slot entry flow model were studied to evaluate that design for use as an HRE-2 replacement core vessel. Spatial residence time and velocity distributions were determined in the model and the data were extrapolated to full-scale temperature conditions. Corrosion rates, core side heat transfer film coefficients, and the spatial mean fluid temperature were estimated for the replacement vessel. Solids and gas removal tests were run. Low core wall temperature and the high velocity of fluid at the wall make this vessel well suited for use as a reactor core. (auth)

3892 (ORNL-TM-68) AN EVALUATION OF A DEUTERIUM-MODERATED GAS-COOLED BREEDER REACTOR. J. W. Miller (Oak Ridge National Lab., Tenn.). Dec. 4, 1961. Contract [W-7405-eng-26]. 49p.

Expanded calculations are presented for the Deuterium-Moderated Gas-Cooled Breeder Reactor. Calculations were performed using the 34-group reactor core GNU in conjunction with the Equilibrium Reactor Program ERC-5. Fuel yields ranging from 3.4 to 4.4% were obtained with fuel cycle costs of 1.3 to 1.5 mills per kwhr. (auth)

3893 (RLI-4(Rev.)) THE BEHAVIOUR OF FISSION PRODUCTS IN PRESSURIZED-WATER SYSTEMS. A Review of Defect Tests on UO_2 Fuel Elements at Chalk River. G. M. Allison and R. F. S. Robertson (Atomic Energy of Canada Ltd., Chalk River, Ont.). Sept. 1961. 26p. (AECL-1338)

Presented at Tripartite Conference on the Transport of Materials in Pressurized-Water Nuclear Systems at Chalk River, February 28-March 1, 1961.

The results of defect tests on UO_2 fuel elements run in loops in the NRX reactor were reviewed from the standpoint of the release of fission products, the behavior of monitors, and release of UO_2. Release rates of Kr^{88}, Xe^{138}, I^{135}, I^{139}, and I^{131} were compared for three defect tests in the X-2 loop on highly rated UO_2. The results were applied to NPD-2 to calculate the contribution of fission-product gases from one defected element to the background activity from uranium contamination. (auth)

3894 (TID-12821) HELIUM CONTAMINANT REMOVAL FEASIBILITY STUDY. Final Report. (Tracerlab, Inc., Western Div., Richmond, Calif.). Nov. 30, 1960. Contract AT(04-3)-341. 17p.

The feasibility of a technique to concentrate reactor coolant contaminants in the minimum by-pass was investigated. The application of this technique to reactors would involve the use of reactor core flux to produce ions in the coolant. Such ions are attracted by an electrostatic field to the orifice of a tube leading to a clean-up system. (J.R.D.)

3895 (CEA-tr-A-995) ASPECTS CHIMIQUES ET ELECTROCHIMIQUES DE LA CORROSION DANS LES REACTEURS. (Chemical and Electrochemical Aspects of Corrosion in Reactors). G. H. Cartledge. Translated into French by M. L. Brini from Werkstoffe u. Korrosion, 9: 493-503(1958). 44p.

A review is presented of the chemical and electrochemical aspects of corrosion with respect to the operation of reactors. The role of electrochemical kinetics is discussed in the light of the phenomena which are produced at the surface which separates the metal from the ambient medium. It is then shown how the conditions in a reactor affect this interface. In the last section of the review the results of corrosion studies made in a homogeneous reactor with an aqueous solution of uranyl sulfate are summarized. (J.S.R.)

3896 (CEA-tr-X-393) APPLICATION DE L'IONISATION DES GAZ À L'INTENSIFICATION DES ÉCHANGES DE CHALEUR. (Effect of Ionization of Gases on Intensifi-

cation of Heat Exchange). F. Berger and V. Stach. Translated into French from Polska Akad. Nauk, Zeszyty Problemowe Nauki Polskiej, 13: 159-77(1958). 37p.

A brief calculation was made of the ionization of the gas in a reactor. The advantageous effect of a nonhomogeneous constant electric field on the coefficient of thermal exchanges with the circulating air was proved. It was established, for given ratios, that this influence is a function of the flow velocity of the air and of the temperature of the heating wire and eventually of the current in the perimeter. The phenomenon studied was explained, and possibilities of its utilization in a reactor was determined. (tr-auth)

3897 REVIEW OF THE NUCLEAR REACTOR CALCULATION METHODS. G. I. Marchuk. Atomnaya Energ., 11: 356-69(Oct. 1961). (In Russian)

The widespread use of computing machines exerted a great influence on the development of the reactor theory and on the calculating methods used. Contributions of Soviet and Western theorists to the mathematical basis of power reactor projects are reviewed. The fields covered include reactors in the thermal, intermediate and fast range, derivation of the basic equations, computing techniques used for solving spheric harmonics equations, multigroup approximations, calculation of heterogeneous systems, determination of the compensating capacity of regulating rods and development of the various computing codes. These methods have great practical usefulness for calculating reactor kinetics programs, reactor life times, compensation of activity, and solution of heat transfer and shielding problems. (80 references). (TTT)

3898 THE FUTURE OF FAST REACTORS. A. I. Leipunskii, O. D. Kazachkovskii, and M. S. Pinkhasik. Atomnaya Energ., 11: 370-8(Oct. 1961). (In Russian)

Complete utilization of U in nuclear technology is dependent on the breeding of the fuel, this is, however, very difficult to realize with reactors operating in the intermediate or thermal neutron range because the breeding ratio of the U–Pu fuel cycle is less than one. Largescale use of U under such conditions would simply exhaust the world's U supplies. Fast reactors have a more favorable breeding ratio and in view of the lower fission cross section the fuel concentration of the core may be reduced. They require, however, special heat transfer agents such as liquid metals because water and organic liquids cannot be used in view of their moderating properties. In order to evaluate the effect of operational factors, an engineering fast reactor project, designated as BR-5, was initiated in the Soviet Union. This Na-cooled reactor has a design power level of 5000 kv(t) with a fast neutron flux of 10^{15} n/cm^{2}sec. The reactor will allow testing of a heat transfer system including radioactive Na and will use high burnup fuels under ultimate power reactor conditions. Fast-reactor kinetics and behavior of engineering materials exposed to high fast-neutron fluxes will be studied. The reactor will use Pu oxide fuel which was found to be more suitable than metallic Pu. The Na circulates at a rate of 5 m/sec through the core at a maximum temperature of 500°C; NaK alloy is used as secondary coolant. Fuel fabrication expenses are expected to be low and the spent fuel may be treated by the usual hydrochemical methods. (TTT)

3899 FUEL AND ITS CHARACTERISTICS FOR SEMIHOMOGENEOUS REACTORS. Ryuzo Ueda. Genshiryoku Kôgyô, 6: No. 9, 7-10(1960). (In Japanese)

Cooling systems including gas and bismuth as cooling agents are currently under development at the Semi-Homogeneous Reactor Project of the Japanese Atomic Energy Research Institute. In both cases an identical fuel, consisting of homogeneously dispersed, 5-micron diameter U powder in graphite, will be used. This fuel which is able to retain all the fission products within the graphite matrix, presents the advantage of improved neutron economy and a simplified fuel reprocessing. Fuel manufacturing and reprocessing problems are described. (TTT)

3900 UTILIZATION OF PLUTONIUM AND ITS FUEL CYCLE. J. Shimokawa. Genshiryoku Kôgyô, 6: No. 9, 63-7(Sept. 1960). (In Japanese)

The progress report of August 1959 by the Japanese Nuclear Fuel Economy Study Group is clarified. It is attempted to estimate the nuclear fuel requirements of Japan for the next 15 years assuming 7 different fuel cycles. The following conditions were set for the study: 1) Only Calder Hall type reactors are built; 2) only BWR type reactors are built; 3) both of these reactor types are used at the same rate, on basis of the AEC's December 1957 development program. On the basis of these assumptions, the following amounts of natural uranium-based fuels will be required by 1975: 1) $2.3 \cdot 10^4$ tons; 2) $2.1 \cdot 10^4$ tons; 3) $2.2 \cdot 10^4$ tons. Making use of the Pu recycle concept, the following amounts of natural U based fuel may be economized: 1) about $6 \cdot 10^3$ tons; 2) 3.7 to $4.1 \cdot 10^3$ tons; 3) 4.1 to $4.3 \cdot 10^3$ tons. (TTT)

3901 LIMITATIONS TO USE OF VARIOUS NUCLEAR FUELS. J. At. Energ. Soc. Japan, 3: 717-41(Sept. 1961). (In Japanese)

3902 PAIRED-CHAMBER TYPE PILE OSCILLATOR. Toyojiro Fuketa (Japan Atomic Energy Research Inst., Tokyo). Nuclear Instr. & Methods, 13: 35-42(Aug. 1961). (In English)

A pile oscillator, which is improved from a conventional one with the intention of eliminating the effect from the fluctuation of the reactor power by using a method of compensation, is reported. The signal-to-noise ratio is increased by a factor of about 100. The maximum sample size in this oscillator is 17 mm in diameter and about 100 mm in length. The attainable standard deviation of the measured value is less than 0.5×10^{-3} cm^2 in the whole macroscopic cross section $\Sigma_a V$ of the sample. (auth)

3903 THE SOLUTION OF MANY REGION REACTOR KINETICS PROBLEMS ON AN ANALOG COMPUTER. C. N. Kelber, L. C. Just, and N. F. Morehouse, Jr. (Argonne National Lab., Ill.). Nuclear Sci. and Eng., 11: 285-9(Nov. 1961).

In reactor kinetics problems where it is desirable to take the space dependence of reactor flux into account, the time dependent diffusion equation $\int_v \nabla \cdot D\nabla\phi dV - \int_v \Sigma_a \phi dV + \int_v s\, dV = \int_v \frac{1}{\nu}\frac{\partial \phi}{\partial t} dV$ must be solved. The solution of this equation on an analog computer requires a large amount of equipment. If the equation is written in the form, $\int_s D\nabla\phi dS - \int_v \Sigma_a \phi dV + \int_v s\, dV = \int_v \frac{1}{\nu}\frac{\partial \phi}{\partial t} dV$ where the volume integral of the divergence of neutron current is replaced by the surface integral of the current, then a large reduction in the number of mesh points and consequently in the amount of equipment is possible. An example is given and compared with the flux distribution computed on a digital machine. (auth)

3904 THE STATISTICAL ASPECTS OF NUCLEAR REACTOR FUEL ELEMENT TEMPERATURE. Frederick H. Abernathy (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng., 11: 290-7(Nov. 1961).

In designing a heterogeneous reactor it is not enough to be able to calculate the nominal temperature of the fuel

elements; one must be able to calculate the probability that the surface temperature is either less than a given value or lies between given limits. Hence a method of analyzing this problem is presented and applied to a heterogeneous, gas-cooled reactor. It is shown that one need not assume each statistical variable controlling the temperature to be normally distributed. For design purposes, however, one must assume that any value of the parameters, between fixed limits, is equally likely, and that the fuel element surface temperature will be adequately approximated by a normal distribution even though the independent variable has a rectangular frequency function. (auth)

3905 A VOID MEASUREMENT TECHNIQUE FOR LOCAL BOILING. H. C. Perkins, Jr., M. Yusuf, and G. Leppert (Stanford Univ., Calif.). Nuclear Sci. and Eng., 11: 304-11(Nov. 1961).

A beta attenuation method is developed for measuring void fractions which is sensitive enough for use during local boiling. Comparisons are made with gamma attenuation methods, the effects of preferential void location are demonstrated, and typical void fractions measured during forced-convection, subcooled boiling of water are presented. The technique is found to be readily applicable to the accurate determination of void fractions during either saturated or subcooled boiling of water and organic liquids. (auth)

3906 METHOD OF STUDYING XENON SPATIAL INSTABILITY WITH AN ANALOG COMPUTER. R. M. Pearce (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nuclear Sci. and Eng., 11: 328-37(Nov. 1961).

The spatial flux oscillations that may occur in a power reactor as a result of xenon and local temperature effects are studied on a general-purpose electrical analog computer. The linearized forms of the two-group diffusion equations with xenon-dependent coefficients are solved in one dimension using finite space intervals. The xenon-dependent coefficients are obtained at each space point by solving the linearized forms of the iodine and xenon equations using continuous integration, one second of computer time representing one hour of reactor time. Thus at each space point four operational amplifiers are required—one each for iodine, xenon, fast flux, and slow flux. The present application has ten space points on a radius, or on the half-thickness of a slab, requiring 40 amplifiers and 80 potentiometers. Good agreement is obtained with modal theory for predictions of the threshold fluxes in simple cases. Unlike some applications of modal theory, it is not assumed in the case of a persisting or pure mode that each of the oscillating variables is the product of a real function of space and a function of time. In fact it is found that the space shape changes continually during a cycle of an infinite train of oscillations, this behavior repeating in every cycle. This is partly a result of the xenon's lifetime against burnup varying through the reactor. The change of shape is less marked for the flux and iodine than for the xenon, and is most marked in the case of high equilibrium flux. At a central flux of 2.1×10^{14} cm^{-2} sec^{-1}, the maxima in the xenon occur 2.5 hr later at the outside of a cylinder or of a slab than at the center. Some examples of two-group mode shapes are also given for reflected and flattened reactors. (auth)

3907 THE DEPRESSION OF THERMAL NEUTRON FLUX AND DENSITY BY ABSORBING FOILS. G. C. Hanna (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nuclear Sci. and Eng., 11: 338-9(Nov. 1961).

The depression in neutron flux resulting from the introduction of an absorbing foil into a diffusing medium is compared with experimental data on how activation per unit mass decreases with increasing foil thickness and area. Comparisons of calculated fluxes with experimental data show that the data are not strictly valid, because the latter, being measurements of the activity of 1/v absorbers, are measurements of neutron density. Many flux measurements are made with foils so thin that the distinction is not of practical importance, but it should not be ignored when calculations and measurements of flux depression are being compared. Suggestions are made for correcting the calculations and the experimental data. The effects of spectral hardening in thin foils when irradiation is isotropic and the effects of the diffusing medium are also discussed. A tabulation is also given of the variation of flux and density depression with foil thickness. (N.W.R.)

3908 SEARCH FOR A NUCLEAR THERMIONIC EMITTER. Paul Stephas (General Electric Co., Pleasanton, Calif.). Nucleonics, 19: No. 12, 66; 70; 72-3(Dec. 1961).

The characteristics required for thermionic emitter material to coat the nuclear fuel in a thermionic converter are presented and the materials which may have the desired qualities are discussed. Thermionic properties of about 45 materials are listed. The survey shows that the materials that come closest to satisfying all criteria are the carbides and borides of the rare earths and transition metals. (N.W.R.)

3909 NUCLEAR REACTOR START-UP SIMULATOR. W. Filipczak (Inst. of Nuclear Research, Polish Academy of Science, Warsaw). Nukleonika, 6: 387-98(1961). (In Russian)

Physical processes with a parameter changing over a very wide range (e.g. neutron flux in reactors) are investigated with the aid of computer techniques. The method of automatic change of the scale factors of the machine is presented, and a reactor startup simulator applying this method is described. (auth)

3910 INFLUENCE OF THE TEMPERATURE REACTIVITY COEFFICIENT ON THE TRANSIENT TEMPERATURE DISTRIBUTION IN THE ROD TYPE FUEL ELEMENT. Wiesław Ciechanowicz (Inst. of Nuclear Research, Warsaw). Nukleonika, 6: 461-6(1961). (In English)

The influence of the thermal reactivity coefficient on the transient temperature distribution of a fuel element may be calculated by solving the thermal conductivity and reactor kinetics equations. The solutions of these equations, in the case of the coolant temperature not being the function of time and the reactor being nearly critical, are obtained. The disturbance function is a step reactivity change δk which value is less then $\beta = 0.0075$. It enables one to get the kinetics equations as linear differential equations. The solution of these equations is obtained after introducing to them the Laplace and Hankel transforms. (auth)

3911 A UNIFORM PROCEDURE FOR USE IN THE EVALUATION OF NUCLEAR POWER REACTORS. A FORUM Manual. (Atomic Industrial Forum, Inc., New York). Sept. 1959. 44p. $1.50 (Atomic Industrial Forum).

A form was developed for presenting the design data pertaining to a reactor under evaluation, for outlining its anticipated cost performance, and for describing both the current state of its development and the additional developmental requirements. (M.C.G.)

3912 PRESTRESSED CONCRETE PRESSURE VESSELS AT MARCOULE NUCLEAR CENTRE. THE DESIGN OF THE PRESSURE VESSELS. Jean Bellier. THE

CONSTRUCTION OF THE PRESSURE VESSELS. Max Tourasse. London, Cement and Concrete Association, 1960. 28p. (Translated by C. V. Amerongen from Suppl. to Ann. inst. tech. bâtiment et trav. publ., (July-Aug. 1959)).

The design and construction of the prestressed concrete pressure vessels of the Marcoule Reactors (G-2) and (G-3) are described. The pressure vessels are designed for use as a biological shield as well as the reactor containment. The pressure vessels are designed in such a manner that charging and discharging are effected while the reactors are in operation, without the reactions having to be stopped or the pressure lowered. The pressure vessels are lined with a highly-ductile steel plate of 30 mm thickness in order to insure complete gas tightness. (N.W.R.)

3913 NUCLEAR FUEL ELEMENTS AND METHOD OF MAKING THE SAME. Clarence Irving Justheim and Morgan Gurdon Huntington (to RNB Corp.). British Patent 882,000. Nov. 8, 1961.

A method is outlined for cladding fissionable and fertile reactor fuels in such a way that the disadvantages of conventional metal and ceramic claddings are avoided. In this method, fuel particles or pellets are surrounded with a thermally setting material which evolves gas upon heating, the mixture is subjected to induction heating so that the fuel particles are preferentially heated to initiate gas evolution in their neighborhood, and a bubble or cell forms around each particle. Thus, a space is provided around each fuel particle to allow for volume increases due to thermal or radiation effects, and the matrix itself contains the fission products and hence requires no external cladding. The thermal setting material preferably is bituminous coking coal which passes through a plastic range at a temperature between 700 and 900°F with evolution of gases. (D.L.C.)

3914 SAMARIUM COMPENSATOR. Ira Bornstein (to North American Aviation, Inc.). British Patent 882,117. Nov. 15, 1961.

The formation of an equilibrium concentration of Sm^{149} with a high poisoning effect in U^{235} fuel necessitates the addition of excess reactivity to reactor cores to compensate for the poisoning. However, since the Sm^{149} equilibrium concentration takes quite a long time to build up, especially in reactors with low neutron flux, there is a danger of runaway in the initial period of reactor operation due to the excess reactivity. This danger can be alleviated simply by adding to each fuel element an amount of Sm^{149} equivalent to one to two times the amount of the Sm^{149} equilibrium concentration. The optimum proportion of natural Sm_2O_3 for addition to UO_2 in this manner is ~0.068 wt. % relative to the weight of $U^{235}O_2$ present. (D.L.C.)

3915 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Jack Moore (to United Kingdom Atomic Energy Authority). British Patent 882,224. Nov. 15, 1961.

A method is given for reducing reaction between reactor coolant and fuel elements in case of sheath leaks in a gas-cooled reactor. The method comprises mixing a minor proportion of a gas inert to the fuel with the coolant gas so that, in event of leaks, the inert gas builds up around the exposed fuel and eventually stops the reaction. For a CO_2-cooled reactor, the presence of 0.1 to 1% He in the coolant limits the formation of oxide on a uranium fuel member to a tolerable level. (D.L.C.)

3916 IMPROVEMENTS RELATING TO CONTROL MEANS FOR NUCLEAR REACTORS. George Camac (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 882,361. Nov. 15, 1961.

An apparatus is designed for rapidly shutting down a reactor in the event of failure of normal control and shutting down means. The apparatus comprises a reservoir of neutron absorbent material in a fluidized form located above the reactor core, a duct normally empty leading from the reservior to within the core, means for passing the neutron absorbent material into the duct upon receipt of an operating signal, and means for subsequently removing the material from the core. The material may be in the form of pellets or small particles. Various possible embodiments of the apparatus are described. (D.L.C.)

3917 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Andre Huet. British Patent 882,598. Nov. 15, 1961.

A tubular fuel element is designed with helicoidal channels connecting the outer surface of the element to the axial channel within the element. The element may take a variety of shapes, such as a frusto-conical shape with an axial channel of cylindrical or frusto-conical shape. The advantages of this element design are better heat transfer and, in the case of boiling reactors, separation of water and steam in the helicoidal channels due to the centrifugal effect and superheating of steam in the axial channel. (D.L.C.)

3918 IMPROVEMENTS RELATING TO DEVICES FOR SUPPORTING FUEL ELEMENTS IN A NUCLEAR REACTOR. John Anthony Collis-Smith (English Electric Co., Ltd.). British Patent 882,633. Nov. 15, 1961.

A support device is designed for supporting fuel elements in reactor fuel channels. The device comprises a sleeve with latches adapted to lock into recesses in the channel wall. A loading ram for inserting or removing the support device and supported fuel elements is also provided. (D.L.C.)

3919 CONTROL RODS FOR NUCLEAR REACTOR CORES. Francis Robert Bell (to De Havilland Engine Co., Ltd.). British Patent 882,636. Nov. 15, 1961.

A reactor control rod is designed which has increased effectiveness as compared with the width of the aperture in the pressure vessel through which it passes. The control rod carries six fins, three on each side, and two of the fins are fixed while the other, being adjustable, is capable of movement from between the fixed fins to an extended position. Thus, the control rod assembly can be arranged so that the parts within the core form a substantially complete shell around the reactor central axis, while the apertures on the pressure vessel wall are well spaced for strength. (D.L.C.)

3920 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Roy Alfred Ulfketel Huddle and Gerald Arthur Hughes (to United Kingdom Atomic Energy Authority). British Patent 882,651. Nov. 15, 1961.

A reactor fuel element for heterogeneous reactors is designed in which the neutron expense of a high cross section canning material is minimized. The element comprises a beryllia moderator hexagonal rod with uranium-containing plates inserted in recesses in each face and clad with stainless steel or chromized mild steel. A plurality of such elements may be held in a parallel relationship in a reactor by ceramic spacers at the corners of the hexagons. The advantages of this element design are that the thermal stresses in the moderator are reduced and that the coolant forces the can against the fuel inserts, providing good heat transfer to the can. (D.L.C.)

3921 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Norman George Worley, George Erasmus Darwin, and John David Dell (to Babcock & Wilcox Ltd.). British Patent 882,670. Nov. 15, 1961.

A reactor fuel element is designed which comprises a bank of fuel rods within an open-ended sleeve. The rods are situated transversely to the coolant flow and are supported from opposed plates contained within the sleeve. Fuel elements of this type in any one coolant channel are joined end-to-end by links so that they may be moved as one unit. (D.L.C.)

3922 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. (to Siemens-Schuckertwerke A. G.). British Patient 882,689. Nov. 15, 1961.

A pressurized water reactor plant is designed for superheating the turbine working medium. The reactor has two separate primary cooling circuits which are coupled to the working medium circuit via heat exchangers; one circuit operates with pressurized water, while the other circuit operates with a gaseous medium, usually steam. Thus, superheating operation is obtained along with the advantages of pressurized water reactor operation. (D.L.C.)

3923 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Sydney Fawcett, Richard Valentine Moore, and Burton Cutts (to United Kingdom Atomic Energy Authority). British Patent 882,714. Nov. 15, 1961.

A gas-cooled, graphite-moderated reactor is designed for eliminating or mitigating the positive reactivity coefficient due to temperature variation of the moderator. In this reactor, a portion of the coolant is reversed in flow at one end of the moderator and caused to flow, in contradirection to the flow through the moderator, in contact with the fuel elements. In this way, the moderator is more effectively cooled. (D.L.C.)

3924 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Charles Raymond Faulkner and Peter Brock (to United Kingdom Atomic Energy Authority). British Patent 883,196. Nov. 29, 1961.

A reactor fuel element is designed consisting of a series of tubular fuel segments arranged end-to-end within protective inner and outer sheaths with a space between one end of the segment chain and the adjacent end of the sheaths. A restraint member is provided in the space to prevent lengthwise movement of the fuel chain, the member having a limited strength so that it will fail in compression before stressing the sheaths beyond their elastic limit. (D.L.C.)

3925 NUCLEAR REACTOR COOLANT SYSTEM. (to Esso Research and Engineering Co.). British Patent 883,241. Nov. 29, 1961.

A reactor coolant having superior cooling properties is a hydrocarbon which undergoes endothermic dehydrogenation within the reactor core and hydrogenation outside the reactor. The hydrocarbon preferably is cyclohexane giving benzene upon dehydrogenation, and the dehydrogenation and hydrogenation processes are carried out respectively on fuel element surfaces and heat exchanger surfaces coated with appropriate catalysts. The advantages of this cooling system are that 2.5 to 10 times more heat per lb fluid can be removed from the core (1200 Btu per lb cyclohexane) than by boiling water coolant, a lower coolant pressure is required, non-corrosive conditions are obtained, and the fuel elements are maintained at constant temperature by the self-regulating cooling system. A reactor configuration giving 250 Mw(th) with the cooling system is described. (D.L.C.)

3926 IMPROVEMENTS IN NUCLEAR REACTORS. Anthony James Taylor and James Simon Picton (to Babcock & Wilcox Ltd.). British Patent 883,501. Nov. 29, 1961.

A restrictor for limiting gaseous coolant flow in a reactor fuel channel is designed so that it cannot be blown out of the channel when fuel elements are removed from the channel. The horizontal cross section of the restrictor is small so that the upward thrust is correspondingly small and the restrictor is secured in place by the weight of the fuel element support unit. (D.L.C.)

3927 NUCLEAR REACTOR FUEL ELEMENT. (to U. S. Atomic Energy Commission). British Patent 883,678. Dec. 6, 1961.

A reactor fuel element for use in high-temperature gas-cooled reactors at temperatures above 1000°F is designed which incorporates a fission product trapping apparatus. The element comprises a plurality of fuel slugs canned by impervious graphite and disposed loosely within an outer shell, and a plurality of fission product traps (both chemical and physical) connected to the space between the shell and the slugs. A radiation monitoring system is also provided to check on the condition of the core and individual fuel elements. The fuel preferably is an admixture of uranium and thorium carbides with graphite moderator. The characteristics of a 60-Mw reactor and a 400-Mw reactor employing the described fuel element are summarized. (D.L.C.)

3928 IMPROVEMENTS IN NUCLEAR REACTORS. John William Edmund Campbell and Peter Thomas Hilliard (to Babcock & Wilcox Ltd.). British Patent 883,716. Dec. 6, 1961.

A pressurized water reactor is designed with an advantageous fuel element-control rod arrangement and which is suitable for use on ships. The arrangement comprises fuel element chambers alternated with control rods, each of which are provided with longitudinal ribs extending between chambers. Upper and lower core support means are designed for lightness and rigidity. (D.L.C.)

3929 IMPROVEMENTS IN NUCLEAR REACTORS. John William Edmond Campbell (to Babcock & Wilcox Ltd.). British Patent 883,717. Dec. 6, 1961.

A reactor of the heterogeneous, liquid-moderated type is designed in which the surface area of control rods is increased with a relatively small number of control rods, and which is suitable for mobile use, e.g., on ships. The core comprises rows of fuel element chambers alternating with rows of control rods, each control rod being formed with four longitudinal ribs extending between fuel element chambers. The core support is designed for lightness, rigidity, and shock resistance. (D.L.C.)

3930 NUCLEAR REACTORS. Edward Chester Creutz, Leo Arthur Ohlinger, Alvin Martin Weinberg, Eugene Paul Wigner, and Gale Jay Young. British Patent 883,752. Dec. 6, 1961.

A reactor of the heterogeneous type is designed. In this reactor, coolant passageways are formed in the moderator and uranium rods disposed therein with longitudinal ribs between the rods and the passageway walls. The uranium rods are tubular with central channels for a coolant. Both the passageways and the rod channels are lined with a material impermeable to fission products. (D.L.C.)

3931 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. John Jeffrey Stubbs (to English Electric Co., Ltd.). British Patent 883,901. Dec. 6, 1961.

A container for use in loading and unloading reactors

under load is designed with means for reducing the thermal shock experienced by the fuel elements lowered into the reactor. The container is arranged to house a plurality of fuel elements and has means for heating the elements in situ. The heating means comprise a heater and a fan for circulating a gas in a closed circuit. (D.L.C.)

3932 METHOD FOR PRODUCING HIGH STRENGTH CONTROL RODS FOR NUCLEAR REACTORS AND CONTROL RODS PRODUCED THEREBY. (to U. S. Atomic Energy Commission). British Patent 883,986. Dec. 6, 1961.

A method is outlined for making a reactor control rod with higher strength properties (yield strength >15,000 psi at 550 to 600°F) and suitable for use in military and naval reactors. The method comprises forming a fine powder of an alloy composition with a thin oxide coating, preparing a sintered billet from the powder, and shaping the billet to result in a control rod with an oxygen content of 0.1 to 0.3 wt %. The alloy composition consists of 65 to 85 wt % Ag, 2 to 20 wt % In, 0 to 10 wt % Cd, 0 to 5 wt % Sn, and 0 to 1.5 wt % Al; the amounts of each metal employed is determined by the equation X + 2Y + 3Z + 3W + 4V = 1.4 to 1.3, where X, Y, Z, W, and V are the atom fractions of Ag, Cd, In, Al, and Sn, respectively. Creep-rupture data are given for this material. (D.L.C.)

3933 FUEL ELEMENT FOR NUCLEAR REACTORS. C. H. Bassett (to U. S. Atomic Energy Commission). U. S. Patent 3,009,869. Nov. 21, 1961.

A fuel element is designed which is particularly adapted for reactors of high power density used to generate steam for the production of electricity. The fuel element consists of inner and outer concentric tubes forming an annular chamber within which is contained fissionable fuel pellet segments, wedge members interposed between the fuel segments, and a spring which, acting with wedge members, urges said fuel pellets radially into contact against the inner surface of the outer tube. The wedge members may be a fertile material convertible into fissionable fuel material by absorbing neutrons emitted from the fissionable fuel pellet segments. The costly grinding of cylindrical fuel pellets to close tolerances for snug engagement is reduced because the need to finish the exact size is eliminated. (AEC)

3934 COOLANT STABILIZED WITH KETONE. J. G. Burr and J. D. Strong (to U. S. Atomic Energy Commission). U. S. Patent 3,009,881. Nov. 21, 1961.

A method is given for inhibiting radiolytic damage to a polyphenyl composition undergoing nuclear irradiation, the polyphenyl composition initially consisting essentially of polyphenyls having 2 to 4 phenyl rings. The method comprises adding approximately 5 mole % anthraquinone to the polyphenyl composition. (AEC)

3935 NUCLEAR REACTORS. Leonard J. Koch, Ralph E. Rice, Jr., Alexander A. Denst, Anthony J. Rogers, and Meyer Novick (to U. S. Atomic Energy Commission). U. S. Patent 3,011,962. Dec. 5, 1961.

An active portion assembly for a fast neutron reactor is described wherein physical distortions resulting in adverse changes in the volume-to-mass ratio are minimized. A radially expandable locking device is disposed within a cylindrical tube within each fuel subassembly within the active portion assembly, and clamping devices expandable toward the center of the active portion assembly are disposed around the periphery thereof. (AEC)

3936 RADIATION FACILITY FOR NUCLEAR REACTORS. E. L. Currier, Jr. and J. H. Nicklas (to U. S. Atomic Energy Commission). U. S. Patent 3,012,956. Dec. 12, 1961.

A radiation facility is designed for irradiating samples in close proximity to the core of a nuclear reactor. The facility comprises essentially a tubular member extending through the biological shield of the reactor and containing a manipulatable rod having the sample carrier at its inner end, the carrier being longitudinally movable from a position in close proximity to the reactor core to a position between the inner and outer faces of the shield. Shield plugs are provided within the tubular member to prevent direct radiation from the core emanating therethrough. In this device, samples may be inserted or removed during normal operation of the reactor without exposing personnel to direct radiation from the reactor core. A storage chamber is also provided within the radiation facility to contain an irradiated sample during the period of time required to reduce the radioactivity enough to permit removal of the sample for external handling. (AEC)

Power Reactors

Refer also to abstract 3266

3937 (ASD-TR-61-281) FISSION HEAT DIODE CONVERTER. Period covered: March 7, 1960 to April 30, 1961. Gene R. Feaster, M. Gottlieb, and R. J. Zollweg (Westinghouse Electric Corp. Electronic Tube Div., Elmira, N. Y. and Westinghouse Electric Corp. Research Labs., Pittsburgh). May 31, 1961. Contract AF33(616)-7198. 64p.

Thermionic conversion of fission heat using cesium vapor diodes offers promise as an electrical power source for space vehicles. Research and development work on cesium vapor diodes is reported, as well as a state-of-the-art survey and an extensive bibliography. Experimental and/or theoretical results are given in the following areas: effect of gas adsorption on the emission from cesiated tungsten; plasma oscillations; thermal conductivity of cesium vapor; electron scattering in cesium vapor; effect of varying cesium pressure, cathode temperature, and spacing in a cesium cell; construction techniques and materials problems. The use of plasma oscillations to generate alternating current is discussed and an analysis showing that the use of hybrid thermionic-thermoelectric systems in space is not favorable, is included. (auth)

3938 (CEND-127) DEVELOPMENT OF STEAM SEPARATION DEVICES. Interim Report. (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Apr. 1961. Contract AT(11-1)-795. 70p.

Results are presented from tests on gravity steam-water separator devices. The test apparatus is described and illustrated. The program for the development of steam separation devices is concerned with the investigation of internal steam separation arrangements for use in an integral-type nuclear boiler-superheater reactor. Data are appended. The feasibility of using gravity steam separation in the reference design for the Large Nuclear Superheat Reactor (NUSU) was verified. (C.H.)

3939 (CVNA-72) CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC. RESEARCH AND DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT FOR THE PERIOD OCTOBER–NOVEMBER–DECEMBER 1960. (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Contract AT(30-1)-2289. 225p.

Progress is reported on nuclear design, pressure tube assembly development and analysis, fuel development, irradiation experiments, materials development and fabrication techniques, chemical surveillance and evaluation of CVTR materials and systems, component development,

plant system development, instrumentation and control, safety analysis and evaluation, and critical experiments. (M.C.G.)

3940 (GEAP-3781) FUEL CYCLE PROGRAM. A BOILING WATER REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Report No. 4, April 1961–June 1961. J. A. Hodde (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Aug. 1, 1961. Contract AT(04-3)-189. 42p.

Twenty-one Zircaloy-clad assemblies were fabricated and delivered to VBWR during the period. Several Zircaloy rods were damaged during a heat treatment overtemperature accident; data concerning the overtemperature effects on these rods are included. Design changes in instrumented fuel assemblies are reported, and developement of the plan of attack and core arrangement for VBWR stability testing are described. VBWR startup tests were completed. In the fuel irradiation program, stainless steel clad assemblies were irradiated to approximately 680 Mwd/t and Zircaloy fuel assemblies were irradiated to an average of 35 Mwd/t. In heat transfer and fluid dynamics development, single rod burnout tests were completed and data obtained in high pressure observational boiling experiments are summarized. In experimental physics tests are outlined and the core location specified for the two fuel assemblies to be used in the long-term reactivity experiment. The plutonium recycle program is described and working arrangements between this program and the fuel cycle program are summarized. (J.R.D.)

3941 (GNEC-190) NUCLEAR SUPERHEAT DEVELOPMENT PROGRAM. Eighth Quarterly Progress Report, April–June 1961. (Combustion Engineering, Inc., Windsor, Conn. and General Nuclear Engineering Corp., Dunedin, Fla.). Contract AT(11-1)-795. 177p.

A study of the effect of outlet steam temperature and pressure on the performance of the NUSU reactor was initiated. The preliminary study of the NUSU concept with 900°F, 925 psia outlet steam, indicated that some dimensional changes in the double-annular fuel element are necessary. Tentative thermal analysis of the modified double-annular fuel element for the lower steam conditions, indicated a maximum wall temperature only slightly higher than the maximum at an exit steam velocity of 122 ft/sec. Steam tests showed that a significant downcomer entrainment problem exists at velocities greater than about 0.75 ft/sec. A limited study of the alternate NUSU reference design with multitube fuel elements was devoted to the peripheral boiler region of the core. Analysis of critical experiments with the NUSU double-annular fuel elements was initiated, using the Deutsch semi-empirical method of computing three-group constants. The results of calculations in the uniform core arrays using the modified Deutsch method showed good agreement with the experimental values of both reactivity and power distribution. Further study of the methods of heat-transfer analysis of the multitube fuel-element concept showed that a finer mesh network is required in the relaxation method for accurate results. An investigation of the basic methods of calculating pressure drops was undertaken. The NUSU critical experiments were completed. Four-group burnup calculations are being made on the reference NUSU design. A series of tests on mechanical steam-water separators was concluded. Fabrication methods for the in-pile test fuel element were developed. The thermal cycle tests of the prototype fuel element were completed. (M.C.G.)

3942 (NDA-2132-6) A STUDY OF WET STEAM AS A REACTOR COOLANT. Joint Summary Report covering Period October 1, 1959–May 31, 1961. (Centro Informazioni Studi Esperienze, Milan; Ansaldo S. p. A., Genoa; and United Nuclear Corp. Development Div., White Plains, N. Y.). Sept. 10, 1961. Contracts AT(30-1)-2303; EUR/C/1865/2/59; and EUR/C/2349/1/59 f. 55p. (CISE-R-44)

Wet steam under dispersed flow conditions (fog or spray flow) was studied as a coolant for nuclear power reactors. The work accomplished included extensive heat transfer and hydrodynamics measurements, corrosion and erosion tests under aggravated conditions, exploration of means for efficient coolant mixing and separation, and theoretical examination of the experimental data. A preliminary design of a 300 Mw(e) light water-moderated reactor, using wet steam under fog flow conditions as the coolant, indicated a power generation cost in the range of 6.5 mills/kwh and a capital cost of about $200/kw(e), estimated on the basis of USAEC technical and economic ground rules used in conjunction with the recently concluded Steam-Cooled Power Reactor Evaluation. Improved operational nuclear safety characteristics are indicated over boiling water reactor systems. (auth)

3943 (ORNL-3157) EXPERIMENTAL STRESS ANALYSIS OF EGCR PRESSURE VESSEL. PART 1. EXPERIMENTAL DETERMINATION OF STRESSES IN MODEL. R. W. Holland and R. L. Maxwell. PART 2. INTERPRETATION OF EXPERIMENTAL RESULTS AND EXAMINATION FOR STRUCTURAL INTEGRITY. F. J. Witt, L. R. Shobe, B. L. Greenstreet, M. E. LaVerne, and R. L. Maxwell (Oak Ridge National Lab., Tenn.). Nov. 28, 1961. Contract W-7405-eng-26. 279p.

Structural evaluations of the upper head of the EGCR pressure vessel were made. The configuration throughout the cluster region in the vessel was found to be structurally adequate. The primary and primary-plus-secondary stress intensities for the burst-slug detection and gas outlet nozzles were found to be within the allowable limits. However, the complete design evaluations of these units cannot be made until the temperature distributions are known. (auth)

3944 (PRDC-TR-49) MONTHLY TECHNICAL REPORT [ON FERMI REACTOR], JULY 1961. (Power Reactor Development Co., Detroit). Contract AT(11-1)-476. 12p.

Progress is reported on core design, the graphite problem, nuclear engineering, mechanical handling, electrical and instrumentation, liquid metal and steam systems, and test operations. (M.C.G.)

3945 (TID-8536) STEAM-COOLED POWER REACTOR EVALUATION. (Division of Reactor Development, AEC). Apr. 1, 1961. 191p.

The technological status and economic potential of steam-cooled (nuclear superheating) power reactors were studied. The following concepts were selected for detailed analyses: Graphite-Moderated Boiling and Superheating Reactor, Integral Boiling and Superheating Reactor, Integral Superheating Reactor, Mixed-Spectrum Superheating Reactor, Once-Through Superheating Reactor, Pressure-Tube Superheating Reactor, Steam-Cooled D_2O Moderated Reactor, Steam-Cooled Fast Breeder Reactor, Separate Superheating Reactor, and Zirconium Hydride-Moderated Boiling and Superheating Reactor. (M.C.G.)

3946 (TID-13389) INTERIM PROGRESS REPORT ON REPAIRING THE TOP HEAD FLANGE OF THE ELK RIVER REACTOR VESSEL. Supplement B to the Allis-Chalmers Report of May 19, 1961, on the Elk River Reactor Vessel Cladding Defects. R. K. Stiles (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). Aug. 4, 1961. Contract AT(11-1)654. 27p.

The progress of repair and inspection work on the top head flange of the Elk River Reactor vessel is summarized. (M.C.G.)

3947 (TID-14088) MONTHLY OPERATING REPORT, SEPTEMBER 1961. VOLUME IV, ISSUE 9. (Duquesne Light Co., Shippingport, Penna.). Contract AT-11-1-292. 42p.

The report is divided into eight major sections: summary of report, station activity report, operations, refueling, maintenance, test program, training program, and construction. The major part of the refueling operation consisted of replacing the depleted Seed 2 with the new Seed 3 fuel elements. (D.L.C.)

3948 (FTD-TT-61-151) OPERATIONAL EXPERIENCE FROM THE FIRST ATOMIC ELECTRIC POWER STATION. Yu. V. Evdokimov (Yevdokimov), V. Ya. Kozlov, V. G. Konochkin, L. A. Kochetkov, A. K. Krasin, V. V. Lytkin, V. S. Severyanov, B. A. Semenov, and G. N. Ushakov. Translated from Atomnaya Energ., 11: No. 1, 12-18(July 1961). 14p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no.28827.

3949 ECONOMIC ASPECTS OF THE NUCLEAR SHIP PROPULSION. A. A. de Boer. Econ.-statist. Ber., 46: 398-400(1961).

It is calculated that the cost of nuclear ship propulsion are about equal to that of conventional propulsion. For nuclear ships the optimum lies at higher speeds and larger carrying capacity. This means that the cost for nuclear propulsion can be reduced by increase of the speed, when the cost for conventional propulsion, by the effect of increasing bunker room, already tends upward. A comparison between ship transport and air transport is also made. (NPO)

3950 OPERATION OF NUCLEAR POWER PLANTS OF THE U. S. ATOMIC ENERGY COMMISSION. NO. 1. Engineer, 212, 841-4(Nov. 17, 1961).

Operating characteristics of the various nuclear power plants in the United States are discussed. Of particular interest are the data on everyday plant operating experience and on radiation intensities encountered during operating and maintenance periods. Pressurized water and boiling water reactors are the types discussed, their performance being demonstrated by the Shippingport Pressurized Water Reactor, Fort Belvoir Pressurized Water Reactor, and Borax Boiling Water Reactors. (N.W.R.)

3951 PNEUMATIC TEMPERATURE PROBES FOR GAS-COOLED REACTORS. Lester L. Kintner (Allis-Chalmers Mfg. Co., Washington, D. C.), Donald A. Lampe and Aikman Armstrong. Nuclear Sci. and Eng., 11: 318-23(Nov. 1961).

The pneumatic temperature monitoring system for the Experimental Gas-Cooled Reactor (EGCR) is designed to measure individual fuel channel coolant temperatures during the reactor lifetime. The pneumatic system is superior to a fixed thermocouple system if it can be maintained to operate with the desired accuracy, throughout the reactor lifetime. The initial cost of the pneumatic system, when integrated with the burst fuel element detection system, is less than that for an equivalent replaceable thermocouple system. The in-reactor portion of the pneumatic system is being installed during initial construction of EGCR as a backup for a fixed thermocouple system. The remainder of the system may be installed after initial reactor operation, to determine whether long term operation and maintenance is economically feasible. (auth)

3952 NUCLEAR POWER PLANTS (USSR). E. Koptelov. Tekhnika Molodezhi, No. 9, 8-9(Sept. 1961).

The nuclear power plant in Voronezh Oblast is equipped with a water-water reactor. The active section of the reactor consists of a steel casing 2.5 m high and 3 m in diameter with 343 hexahedral cells. Hermetically sealed thin tubes containing uranium dioxide enriched to 1.5% are fastened inside the cells. Water is pressurized to 100 atm; steam generated at 32 atm is fed into three 700 Mev turbines. The efficiency of the plant is 27.5%. The Beloyarskaya uranium-graphite nuclear power plant is being built in the Urals on the shores of an artificial lake. The basic structures are completed. Certain improvements are claimed to be firsts in the field. One such is the method of superheating the steam directly in the reactor. Primary steam temperature is 340°C and pressure 155 atm; secondary steam temperature is 320°C and pressure 110 atm. The saturated steam is directed into channels located in the central part of the active section, where the temperature is raised to 510°C. The reactor is constructed without a casing; the graphite stack is placed in a thin-walled jacket filled with nitrogen to avoid oxidation of the graphite. The high steam pressure is obtained in the working channels. This reactor's loading capacity of 90 tons of uranium insures continuous operation for up to 750 days, compared with 1½ years for the Voronezh reactor. The efficiency of the Beloyarsk Plant is calculated at 35 to 37%. (OTS)

3953 POWER REACTOR TECHNOLOGY. Technical Progress Review, Vol. 4, No. 4. Walter H. Zinn (General Nuclear Engineering Corp., Dunedin, Fla.). Sept. 1961. 112p. $0.55(GPO) (Domestic), $0.70(GPO) (Foreign)

Reviews are presented of selected recently published reports in the fields of power-reactor research and development, applications, design practice, and operating experience. The intention is to cover the various areas of reactor development from the general viewpoint of the reactor designer. Some of the fields covered are economics, reactor physics, heat transfer, shielding, instrumentation, thorium fuel cycles, control-rod materials, and steam systems. (D.L.C.)

3954 IMPROVEMENTS IN POWER PLANT. Martin Charles Peters (to Babcock & Wilcox Ltd.). British Patent 879,260. Oct. 11, 1961.

A power plant for nuclear reactors is designed for improved cycle efficiency. In addition to the usual heat exchanger for heat transfer from gaseous reactor coolant to water for vaporization, a second heat exchanger is provided between the first heat exchanger and a point between the intermediate-pressure and low-pressure turbine stages. In this way, interstage reheating of the steam is obtained without passage of the steam back to the first heat exchanger. (D.L.C.)

Research Reactors

3955 (JAERI-6003) DESCRIPTION AND HAZARD ANALYSIS OF JAPAN RESEARCH REACTOR (JRR-2). (Japan Atomic Energy Research Inst., Tokyo). 1961. 97p.

A general description of and the safeguard analysis on the Japan Research Reactor No. 2 (JRR-2), which is located at the Japan Atomic Energy Research Institute, Tokai-mura, Japan is presented. The reactor is essentially a heterogeneous type research reactor, using an enriched U MTR type fuel. It is moderated and cooled by heavy water. The target power level and neutron flux are 10 Mw and 10^{14} n/cm^2 sec. The thermal output is designed to be 10 Mw and the thermal shield employs laminated layers of stainless

steel and light water. The reactor is housed in a gas-tight containment building and incorporates manifold safety devices. An emergency cooling system is provided to prevent the fuel elements from melting down, even in case of a catastrophe. Therefore, it is thought that any hazardous condition will not be caused by the reaction in and around the Research Establishment site, by the release of fission gases in such most credible accidents as the run-away. (auth)

3956 (NP-11107) DETERMINACION DEL FLUJO NEUTRONICO TERMICO ABSOLUTO DEL RA-1 Y CALIBRACION DE LAS CAMARAS DE F_3B. INFORME NO. 44. (Determination of the Absolute Thermal Neutron Flux of RA-1 and Calibration of BF_3 Cameras. Report No. 44). Maria D. Bovisio de Ricabarra, Rosa Faradjie de Turjanski, Mauricio Lara Manning, and Guillermo Hernan Ricabarra (Argentina. Comision Nacional de Energia Atomica, Buenos Aires). 1961. 26p.

A study was made on the theory of the activation of a film in a thermal neutron field. The factors are calculated which account for the internal and external autodepressive effect of the neutron field on the film. The advantages are discussed for absolute beta counting in the 4-π proportional counter compared with the mica-windowed Geiger counter. The 4-π counter and its efficiency are discussed. Calibrations are made for the RA-1 and Lara-Bernardini BF_3 cameras, using manganese films, besides the period of the RA-1 stringer No. 1, a value which is useful for the determination of the reactor power. (tr-auth)

3957 (ORNL-TM-44) NEUTRON FLUX AND Cd RATIO MEASUREMENTS IN THE HN-1 BEAM HOLE FOR THREE FUEL LOADINGS OF THE OAK RIDGE RESEARCH REACTOR. A. J. Shor and T. H. Mauney (Oak Ridge National Lab., Tenn.). Oct. 10, 1961. 15p.

Neutron flux measurements were made in the Oak Ridge Research Reactor beam hole HN-1 shield plug, at low reactor power (N_L) with three fuel configurations. The purpose of these tests was to determine the most favorable fuel arrangement in the region of the experimental hole in order to permit minimization of exposure time of an in-pile slurry loop experiment using pure thoria. It was found that the perturbed thermal neutron flux decreased by factors of 2, each 1.4 in., at the forward end of the beam hole. Maximum and average fluxes observed for three fuel configurations were: high, 9.7×10^{13}, 5.6×10^{13}; intermediate, 8.0×10^{13}, 4.7×10^{13}; and present operating, 7.4×10^{13}, 3.8×10^{13}. In the high and intermediate configurations fuel elements were located in the outer row of the lattice adjacent to the beam hole. Cadmium ratios were generally high (22 to 111) implying low available epi-cadmium flux under any of these configurations. (auth)

3958 (CEA-tr-A-999) PROCEDE D'IRRADIATION UTILISE DANS LE REACTEUR FRM. (Irradiation Procedure Used with the FRM Reactor). M. Polermann and W. Marth. Translated into French by P. Monnard from Kerntechnik, 2: 265-67(1960). 17p.

A survey is given of the irradiation procedures used in the Munich Experimental Reactor for both low and high radiation doses. (tr-auth)

3959 ON THE ERECTION OF THE RISØ REACTORS. E. Bryrup. Ingeniøren, No. 2, 21p.(1960). (In English)

An account is given of the design and construction problems dealt with during the erection of the three reactors (DR-1, DR-2, and DR-3) at Risø. The three reactors differ considerably in working principle, construction, and general arrangement, but they are all research reactors with the main purpose of neutron production. (N.W.R.)

3960 CRYSTAL SPECTROMETER MEASUREMENT OF THE MITR THERMAL NEUTRON SPECTRUM. Robert I. Schermer and Gordon Brownell (Massachusetts Inst. of Tech., Cambridge). Nuclear Sci. and Eng., 11: 343-5(Nov. 1961).

A neutron spectrum in the wavelength range $4\text{Å} > \lambda > 0.65\text{Å}$ ($0.005 \text{ ev} < E < 0.2 \text{ ev}$) is measured using a crystal spectrometer. This spectrometer is of novel design, in that it utilizes a beam of neutrons derived from the 2-ft thick heavy water bottom reflector of the MIT reactor and directed vertically downward through the port of the medical therapy room. The results of such measurements are essential to the proper use of the medical therapy facility. The measurements are made using the (111) planes of germanium, copper, and lithium fluoride in reflection. The results are compared with the fitted Maxwellian distribution curve. Characteristics of the spectrometer are discussed along with the effects it has on the spectrum. (N.W.R.)

SPACE APPLICATIONS AND TECHNOLOGY

3961 (AD-257723) CHARGED-COLLOID PROPULSION SYSTEM. R. B. Edmonson and W. C. Miles (Aerojet-General Corp., Azusa, Calif.). Apr. 1961. Contract AF49(638)-656. 12p.

Development work was described on new designs in feed systems for the electrostatic spraying of microscopic droplets of Octaoil with a 3% tetra-n-butyl ammonium picrate additive. This work was necessitated by the discovery of voltage limitations in the porous fiber demand system. (D.L.C.)

3962 (AD-258108) THERMIONIC CONVERSION IN A NUCLEAR-ELECTRIC SPACE PROPULSION SYSTEM. James P. Ditz and Thomas R. Shukay (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). June 1961. 153p.

Thesis submitted to Massachusetts Inst. of Tech., Cambridge.

The theory and experimental performance of the thermionic converter is analyzed for use in power conversion in a nuclear-electric space propulsion system. Electrical propulsion power requirements are shown to demand a minimum ratio of powerplant weight to power in the jet. The elements of a powerplant into which the converter must be integrated are discussed, including compatible nuclear reactor design, radiator, and electrical acceleration devices. The basic theory of the vacuum and cesium converter is presented with special emphasis on efficiency, power output, and lifetime. Theoretical and experimental analyses of the ability of the thermionic converter to provide a low powerplant weight indicated the system concept compares favorably with turbogenerator conversion. (auth)

3963 (AFOSR-1468) MICROWAVE MEASUREMENTS OF MAGNETO-GAS DYNAMIC PLASMAS. R. C. Warder, Jr., M. Brodwin, and Ali Bulent Cambel (Northwestern Univ., Evanston, Ill. Gas Dynamics Lab.). Aug. 1961. Contract AFOSR 49(638)-879. 66p.

The use of microwave probes as a diagnostic tool to determine the electrical conductivity and the dielectric constant of a plasma were adapted to the arc jet facility. An X-band microwave interferometer and a reflection and transmission type experiment were designed and utilized. The microwave techniques were investigated using models and the results showed that the infinite slab hypothesis is invalid for the given plasma slab size using X-band microwaves. (auth)

3964 (AFOSR-1517) CONTINUOUS ACCELERATION OF PLASMA GENERATED BY THE HIGH-INTENSITY ARC. Technical Report VL-2120-12-0. C. Sheer, J. A. Cooney, L. H. Mead, F. R. Sileo, and D. L. Rothacker (Vitro Labs., West Orange, N. J.). Sept. 29, 1961. Contract AF49(638)-329. 95p.

A plasma propulsion system concept is proposed featuring the vaporization of a "solid" plasma propellant in a high-intensity arc to generate a refractory vapor jet in the maximum field region of a magnetic "nozzle." Acceleration of the vapor plasma jet occurs as a result of its interaction with a diverging magnetic field. This concept is considered both theoretically and experimentally. The theoretical work reviews the single particle case and proposes a method for developing the more applicable continuum model. The single-particle approach provides a rational model for the conversion of plasma enthalpy into jet kinetic energy by means of the diverging magnetic field. The proposed continuum model would use a step-wise relaxation technique. The method is carried forward to the point where numerical solutions require a moderate computer program for completion. The major effort is concerned with the design, construction, and operation of an accelerator facility to prove the basic technique. For practical reasons carbon is used exclusively as the propellant. Although this material is known to be unfavorable because of its highly condensible nature and polyatomic form, and because of the low conductivity of its vapor, the operational feasibility of the system is proven. The most significant finding is the strong dependence of specific impulse I_{sp} on ambient pressure. Although the maximum I_{sp} obtained is 300 seconds, at 4 microns pressure, the shape of the Specific Impulse vs. Pressure curve indicates values in the range of 1,000 to 3,000 seconds are obtainable in the high vacuum of outer space. The chief advantages ascribed to the system are: reliability of operation for long periods of time, elimination of the propellant storage and engine wear problems, and an excellent probability for superior performance in the intermediate mission category. (auth)

3965 (MND-P-2291) AERODYNAMIC RE-ENTRY ANALYSIS. TASK 2. THERMOELECTRIC GENERATOR SUMMARY REPORT. Robert Oehrli (Martin Co. Nuclear Div., Baltimore). [1960]. Decl. Apr. 27, 1961. Contract AT(30-1)-217. 41p.

An analytical trajectory and aerothermodynamic analysis of a satellite containing a Task 2 thermoelectric generator was completed. A 300-statute mile circular polar orbit was used for this analysis and the launch was assumed to be from Vandenberg Air Force Base. Results of this study show that upon natural decay from a successful mission, the radio-cerium fuel will burn up in space at high altitude, thus only a very minor amount of radio cerium will be released to the stratosphere. A complete analyses of the fate of the radio-cerium fuel following various aborted launching attempts also was carried out. Charts summarizing the various assumed failures and locations of the fuel following failure are shown. A technical discussion of the methods used in performing the analysis is included in the report. (auth)

3966 (MND-P-2483-2) SNAP PROGRAMS; TASK 8 — STRONTIUM-90 FUELED THERMOELECTRIC GENERATOR DEVELOPMENT. Quarterly Progress Report No. 2, February 1, 1961 through April 30, 1961. W. West (Martin Co. Nuclear Div., Baltimore). Contract AT(30-3)-217. 135p.

Work in the processing of Sr^{90} into heat sources for 4 radioisotope-fueled thermoelectric power generation systems is described. The design and engineering analysis of these thermoelectric generators are discussed. Fuel process flow and associated equipment requirements for remote conversion of Sr^{90} feed material to strontium titanate pellets are covered. Previously evolved technical standards concerning raw fuel material specification were coordinated. (M.C.G.)

3967 (MND-P-2483-3) SNAP 7 PROGRAM; TASK 8 — STRONTIUM-90 FUELED THERMOELECTRIC GENERATOR DEVELOPMENT. Quarterly Progress Report No. 3, May 1, 1961 through July 31, 1961. W. West (Martin Co. Nuclear Div., Baltimore). Contract AT(30-3)-217. 44p.

The SNAP 7 program is being conducted for the purpose

of developing 4 radioisotope fueled thermoelectric power generation systems. An important phase of this program is the processing of Sr^{90} into heat sources for these systems. The thermoelectric reliability breadboard model and the operating model of the 10-watt thermoelectric generator were assembled and prepared for tests. The SNAP 7B and 7D 60-watt thermoelectric generators were designed, materials were received, and fabrication of components was initiated. Fuel process engineering, nuclear chemistry audit, and manufacturing fuel processing equipment achievements are discussed. (M.C.G.)

3968 (MND-P-3014-I) SNAP RADIOISOTOPE SPACE PROGRAMS; TASK 7. Quarterly Progress Report No. 6, January 1 through March 31, 1961. (Martin Co. Nuclear Div., Baltimore). Contract AT(30-1)217. 72p.

Results of radioisotope flight safety analyses and tests are presented. Safety study of a typical Cape Canaveral launch, study of a lunar impact of a radioisotope-fueled thermoelectric generator, upper atmosphere experimental re-entry studies, fuel core heating and ablation, generator burnup, high altitude sampling, and radioisotope shielding code are discussed. (M.C.G.)

3969 (MND-P-3015-III) SNAP PROGRAMS: TASK 6—FUEL TECHNOLOGY DEVELOPMENT PROGRAM. Quarterly Progress Report No. 7, April 1 through June 30, 1961. (Martin Co. Nuclear Div., Baltimore). Contract AT(30-3)-217. 62p.

Progress made in the development of isotope power sources for thermoelectric and thermionic conversion to electrical energy is reported. The Heavy Elements Processing Facility for processing americium and fabricating americium capsules for irradiation was opened and hot operation was begun. Modifications to the americium purification system were completed and checkout operations were begun. Process specifications were established for dissolution of the irradiated capsules and the major equipment for this operation was designed. Experimental work on the purification of curium was continued. Blending and crushing studies were conducted to establish techniques and procedures for preparing curium carbide and for producing homogeneous cermet fuel forms. Investigations were also made into the compatibility of various matrix and container materials with curium carbides and oxides. Flow diagrams for the fuel form and isotope encapsulation processes were completed. A safety analysis was conducted which verified the integrity of the americium capsules during all stages of the irradiation program. (auth)

3970 (NAA-SR-6300) THE SNAP II POWER CONVERSION SYSTEM TOPICAL REPORT NO. 10, SODIUM PUMP DESIGN AND TESTING. Betty A. Snoke and Janis Tiltins (Thompson Ramo Wooldridge Inc., Cleveland). Aug. 5, 1960. For Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif. Contract AT(11-1)-GEN-8, Subcontract N843-FS-101221. 61p. (ER-4106)

SNAP II is the designation for a 3 kw nuclear auxiliary power unit for utilization in a satellite vehicle. The SNAP II system consists of a reactor source which utilizes a mercury Rankine engine for power conversion. Design details and test data for the primary fluid reactor coolant pump used to transfer heat from the reactor to the mercury boiler are described. (auth)

3971 (NAA-SR-6301) SNAP II POWER CONVERSION SYSTEM TOPICAL REPORT NO. 8, MERCURY CONDENSING RESEARCH STUDIES. R. J. Kiraly and Alfred Koestel (TAPCO. Div. of Thompson Ramo Wooldridge Inc., Cleveland). May 31, 1961. For Atomics International. Div. of North American Aviation, Inc., Canoga Park Calif.). Contract AT(11-1)-GEN-8, Subcontract N843FS-101221. 71p. (ER-4442)

Experimental results are summarized for investigations on the condenser fluid mechanics of mercury under zero-gravity, two-phase conditions. Conditions required for interfacial stability in tubes were determined as a function of tube diameters. Correlated two-phase pressure drop data are presented as functions of tube inlet Reynolds number and vapor specific volume. Flow regime stability was studied under zero-gravity and 2.55-gravity conditions and at various Reynolds numbers. The effect of non-condensable gas on flow performance in mercury forced convection condensers was evaluated. (D.L.C.)

3972 (NAA-SR-6302) THE SNAP II POWER CONVERSION SYSTEM TOPICAL REPORT NO. 9, ALTERNATOR ANALYSIS, DESIGN AND DEVELOPMENT. R. L. Bucklin, J. W. Galysh, and Hugh J. Morgan (Thompson Ramo Wooldridge Inc., Cleveland). For Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Contract AT(11-1)-GEN-8, Subcontract N843FS-101221. 56p. (ER-4472)

The 3 kw nuclear auxiliary power unit designated SNAP II is intended for use in a satellite vehicle. The system consists of a reactor heat source, a mercury Rankine engine, and a permanent magnet alternator. The design details, test results, and development of the SNAP II alternator are presented. (auth)

3973 (NAA-SR-6303) SNAP II POWER CONVERSION SYSTEM TOPICAL REPORT NO. 11, ORBITAL FORCE FIELD BOILING AND CONDENSING EXPERIMENT. Paul E. Grevstad (Thompson Ramo Wooldridge Inc., Cleveland). Jan. 15, 1960. For Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif. Contract AT(11-1)-GEN-8, Subcontract N843FS-101221. 112p. (ER-4443)

The characteristics of Rankine space power plants in the zero gravity aspect of the environment of space were investigated. The expected effects of Rankine space power plants are described. Discussions of experimental techniques for studying these phenomena show that this information can be obtained rapidly and economically. Recommendations for a program to supplement SNAP II and similar Rankine space power development efforts in this vital area are made, and consist of: the development and testing of a small system that adequately simulates a complete Rankine system, first in zero gravity and finally, in the complete orbital environment; followed by, the development and similar testing of a complete Rankine system using SNAP II hardware. (auth)

3974 (NP-10961) ION ENGINE TESTING TECHNIQUES. S. G. Forbes, R. F. Kemp, J. M. Sellen, H. Shelton, J. C. Slattery (Space Technology Labs., Inc. Research Lab., Canoga Park, Calif.). Oct. 10, 1961. 37p.

Paper No. 2183-61 presented at American Rocket Society Space Flight Report to the Nation, New York Coliseum, October 9-15, 1961.

Principles and operations are described of three new measuring devices: an optical probe for neutral propellant efflux, an electron-beam probe for ion-beam potential measurements, and an electronic field strength meter for determining the floating potential of an ion engine test vehicle. The optical probe operates by resonance absorption of Cs "D" lines from a gas discharge source. The device can detect a neutral atom density change of about 5×10^9

atoms/cm^2 in the optical beam path and has been used to observe the fluctuations in neutral cesium such as those which occur when a pulsed ion beam strikes a material object. The electron beam probe measures variations in the time of flight of electrons projected through an ion beam. The device measures flight time variations as small as 2×10^{-11} seconds which corresponds to a change of potential of 1 volt over a 10-cm path. Rapid fluctuations in ion engine beam potential under pulsed condition have been observed by this technique. The electric field strength meter employs a multi-element vacuum tube mounted on the surface of a space vehicle in such a manner that the external electric field arising from the vehicle floating potential plays the role of a grid at "infinity." Field sensitivity in the present stage of development is about 1 volt/cm near zero field strength and about 10 volts/cm for large fields. (auth)

3975 (NP-11035) APPLICATION OF NUCLEAR ROCKET ENGINES TO MANNED LUNAR MISSIONS. Hugh M. Henneberry and Robert J. Lubick (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). [1961]. 29p.

Presented at American Rocket Society Space Flight Report to the Nation, New York, New York, October 9-15, 1961.

The application of nuclear rocket engines as upper stages was studied with primary emphasis on manned lunar missions. Investigation of logical boosters to accomodate nuclear upper stages is discussed. The effects of variables such as staging, nuclear engine thrust level, and startup time are also presented. (auth)

3976 (NP-11109) SPACE PROGRAMS SUMMARY NO. 37-II, VOLUME I, FOR THE PERIOD JULY 1, 1961 TO SEPTEMBER 1, 1961. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Oct. 1, 1961. Contract NASw-6. 88p.

Lunar Program. The operations preceding and during the Aug. 23, 1961 launch of Ranger RA-1 are outlined. Progress is reported on various projects: solar corpuscular radiation electrostatic analyzers, vidicon camera-optical telescope assembly, spacecraft antennas, power systems for Rangers, and testing. Planetary-Interplanetary Program. The development of various instrumentation items for Mariner A, a spacecraft for a Venus mission, is described in detail. Deep Space Instrumentation Facility. The tracking of Ranger RA-1 is described, and some telemetry data are given. Research, development, and instrumentation for tracking stations are discussed. (D.L.C.)

3977 (WADD-TR-60-676) OPTICAL METHODS OF MEASURING PLASMA JET TEMPERATURES. H. C. Hottel, G. C. Williams, and W. P. Jensen (Massachusetts Inst. of Tech., Cambridge. Fuels Research Lab.). Contract AF33 (616)-6570. 71p. Apr. 28, 1961.

An extensive literature survey on high temperature gas pyrometry is presented. From it the conclusion was reached that a mirror-backed optical pyrometer would be attractive for measuring temperatures of air-stabilized plasma jets at temperatures to 8000°K, in the 0.01 to 10 atmosphere pressure range. The pyrometer was modified for improved speed and precision of response by use of a multiplier phototube as the receiver. The technique involves alternate display on a CRO screen of signals representing first a single then a mirror-doubled path through a selected portion of the jet, these signals being chopped mechanically at 13 cps. The doubled path signal is attenuated by a neutral density filter of approximately 50% transmittance, to provide a nearly null measurement of much greater accuracy than is possible if the 2-path signal is not attenuated. An interference filter peaking at 5892 Å, with a half width of 7.5 Å, provides near-monochromaticity at the sodium D-line wavelengths. Sodium is added to the jet as an opacifier. Interposition into the light path of neutral density filters theoretically allows measurements to as high as 10,000°K. A plasma jet facility designed and constructed for this work is described. (auth)

3978 ION ROCKET ENGINE. Kenneth W. Ehlers and F. Voelker, III (to U. S. Atomic Energy Commission). U. S. Patent 3,014,154. Dec. 19. 1961.

A thrust generating engine utilizing cesium vapor as the propellant fuel is designed. The cesium is vaporized by heat and is passed through a heated porous tungsten electrode whereby each cesium atom is ionized. Upon emerging from the tungsten electrode, the ions are accelerated rearwardly from the rocket through an electric field between the tungsten electrode and an adjacent accelerating electrode grid structure. To avoid creating a large negative charge on the space craft as a result of the expulsion of the positive ions, a source of electrons is disposed adjacent the ion stream to neutralize the cesium atoms following acceleration thereof. (AEC)

WASTE DISPOSAL AND PROCESSING

Refer also to abstract 3148

3979 (HW-69627) DENSITY EFFECT ON TWO-FLUID FLOW. A FACTOR IN GROUND DISPOSAL OF AQUEOUS WASTE. A. E. Reisenauer and P. P. Rowe (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 1961. Contract AT(45-1)-1350. 17p.

The influence of the density and viscosity differences between radioactive liquid wastes and natural ground water on the movement and dispersion of contaminants was investigated. Experimental equipment and techniques are described which were used to study a two-fluid flow system in porous media with miscible fluids of different densities when the more dense overlies the one of lesser density. A mathematical model was developed using the concepts of velocity potential and a salt potential as a function of density differences which permitted a numerical solution of the flow system. Results are reported from experiments using deaerated water and sodium nitrate solutions with densities of 1.03, 1.06, and 1.10, with a sodium salt of bromthymol blue used as a visible tracer in the salt solution. Density measurements were made at specific points in the flow system. The mathematical model predicted that an increase of potential difference of 0.5 cm across the flow system described would prevent the reverse flow of the salt solution. Experiments with the flow system confirmed the prediction. (C.H.)

3980 (NP-11105) AN EVALUATION OF THE EFFECTIVENESS OF POLYELECTROLYTE COAGULANT AIDS FOR THE REMOVAL OF RADIOACTIVE ISOTOPES BY WATER TREATMENT PROCESSES. Final Report. S. A. Hannah and A. C. Printz, Jr. (Florida. Univ., Gainesville). Aug. 31, 1961. Contract CDM-SR-60-56. 216p.

Eleven polyelectrolyte coagulant aids were studied in conjunction with conventional and modified water treatment processes for removal of Cs^{137}, Sr^{89}, Pm^{147}, I^{131}, and U^{238}. In general, the polyelectrolytes were quite effective in reducing turbidity and its associated activity, resulting from lime soda softening or added clay, but improvements in overall removal of soluble activity were unpredictable and not sufficient to warrant the use of polyelectrolytes for this purpose alone. It is expected that greater benefits would be derived from the coagulant aids in the removal of fall-out products where much of the activity is in an insoluble form. Illite and fullers earth were shown to be good adsorbents for Cs^{137}, while Volclay was effective for removal of Sr^{89}. Small dosages of chlorine were found to increase the adsorption of I^{131} by activated carbon. Recommended procedures are given for removal of individual isotopes and of fall-out products. The coagulant aids are rated according to their relative efficiencies in removal of turbidity and activity. (auth)

3981 (TID-13226) SEA DISPOSAL CONTAINER TEST EVALUATION. (PneumoDynamics Corp. Advanced Systems Development Div., El Segundo, Calif.). June 15, 1961. Contract AT(04-3)-367. 132p. (ASD-4652-F)

Low-level radioactive waste containers typical of those employed in sea disposal were subjected to pressure tests to observe their behavior during actual use conditions. Actual waste packages used by AEC contractors and by licensed commercial waste disposal firms were tested. These packages were representative of containers disposed of in both the Atlantic and Pacific Oceans off the coasts of the United States. They contained a variety of low-level material and were of types varying from 30-gallon steel drums to concrete blocks weighing as much as 15 tons. Testing was accomplished by means of controlled lowering of the containers to water depth of 1000 fathoms. Photographic recording of container behavior during the lowering process was provided by means of underwater cameras set to take pictures of the container at 12-second intervals. During the program, 164 containers were tested. This was accomplished in 98 controlled lowering operations and involved handling 290.6 tons of material. In addition, terminal velocity was measured on containers under free-fall conditions. Results of the test program are presented both in summary and in detail. A selection of test photographs is included and the procedures and equipment used are fully described. (auth)

3982 STUDIES ON PERFORATED PLATE COLUMN DEMISTER. EVAPORATION OF RADIOACTIVE LIQUID WASTE. Tokuro Mizushina (Kyoto Univ), Takeichiro Takamatsu, Nobuo Mitsuishi, Sosuke Ijichi and Hiroshi Kawai. J. At. Energ. Soc. Japan, 3: 679-683(Sept. 1961). (In Japanese)

In order to concentrate the radioactive liquid wastes by evaporation, a perforated plate column is proposed as an eliminator of liquid entrainment in evaporating vapor. Its characteristics for decontamination are studied theoretically and experimentally. Assuming that the mists forming on each stage are completely eliminated at the next stage above, this demister is found to have unprecedented efficiency. When the upward linear velocity in the column is lower than 0.8 m/sec, about 99% of the mists forming on each stage are eliminated at the next stage above. (auth)

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6436	16-3167	Dep.; $2.00(OTS)
6439	16-2962	Dep.; $0.50(OTS)
6448	16-3179	Dep.; $0.50(OTS)
6449	16-3180	Dep., $0.50(OTS)
6463	16-3530	Dep.; $1.75(OTS)
ANL-FGF–		
269a	16-3129	p.177-87 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961
293a	16-3115	p.58-63 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Ill., 1961," Chicago, American Nuclear Society, 1961
ARF–	**(Misc.)**	
2212-2*	16-3442	
AROD–	**(Non-AEC)**	
1538-19	16-3386	See PIBMRI-937-61
ASD–		
4652-F	16-3981	See TID-13226
ASD-TR–	**(Non-AEC)**	
7-532a(IV)	16-3417	
7-785	16-3418	
61-3	16-3443	OTS
61-92	16-2924	OTS
61-124	16-3419	OTS
61-182	16-3444	OTS
61-193	16-3445	OTS
61-216	16-3446	OTS
61-281	16-3937	OTS
61-360	16-3447	OTS
61-511(Vol.II)	16-3519	OTS
61-516	16-3448	
ATL-A–		
121	16-3814	Dep.(mc); $2.60(fs), $0.98(mf) OTS
BM-RI–	**(Misc.)**	
5864*	16-3240	Free (Bureau of Mines)
5879*	16-3061	
5880*	16-3395	
5884*	16-3059	Free (Bureau of Mines)
5892*	16-2925	Free (Bureau of Mines)

Report No.	Abstract No.	Availability
BMI–	**(Misc.)**	
1551	16-3449	Dep.; $0.75(OTS)
1552	16-3520	Dep.; $1.00(OTS)
1553	16-3305	Dep.; $1.50(OTS)
BMI-X–		
178	16-3450	Dep.(mc); $1.60(fs), $0.80(mf) OTS
182	16-3815	$2.60(fs), $0.83(mf) OTS
BNL–		
3149	16-3323	See AEC-tr-4497(p.162-6)
4883	16-2880	J. Nuclear Med. 2: 253-71(1961)
5208	16-3046	J. Phys. Chem. 65: 1937-40(1961)
5501	16-3572	Phys. Rev. 124: 726-35(1961)
5502	16-3633	Phys. Rev. 124: 622-3(1961)
5614	16-3141	p.253-8 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961
5788	16-3751	Dep.(mc); $1.10(fs), $0.80(mf) OTS
BRL-TN–	**(Non-AEC)**	
1394	16-3665	
CAL-RM–	**(Non-AEC)**	
1396-A-1	16-3531	
CEA–	**(French)**	
1734	16-3451	Dep.(mc)
1858	16-3816	Dep.(mc)
CEA-tr–	**(French)**	
A-981	16-3368	Dep.(mc); $4.60(fs), $1.49(mf) JCL
A-995	16-3895	Dep.(mc); $4.60(fs), $1.52(mf) JCL
A-996	16-3191	Dep.(mc); $2.60(fs), $1.10(mf) JCL
A-999	16-3958	Dep.(mc); $1.60(fs), $0.80(mf) JCL
A-1000	16-3036	Dep.(mc); $1.10(fs), $0.80(mf) JCL
R-1236	16-3192	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
R-1351	16-3524	Dep.(mc); $2.60(fs), $0.86(mf) JCL or OTS
R-1371	16-3674	Dep.(mc); $2.60(fs), $0.89(mf) JCL or OTS
R-1375	16-2995	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
R-1377	16-3037	Dep.(mc); $2.60(fs), $1.07(mf) JCL or OTS
R-1378	16-2996	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
X-256	16-3399	Dep.(mc); $1.10(fs), $0.80(mf) JCL
X-281	16-3369	Dep.(mc); $1.60(fs), $0.80(mf) JCL
X-291	16-3370	Dep.(mc); $2.60(fs), $0.92(mf) JCL
X-353	16-3038	Dep.(mc); $1.10(fs), $0.80(mf) JCL
X-393	16-3896	Dep.(mc); $3.60(fs), $1.31(mf) JCL
X-396	16-3371	Dep.(mc); $1.10(fs), $0.80(mf) JCL
CEND–	**(Misc.)**	
127	16-3938	Dep.(mc); $6.60(fs), $2.30(mf) OTS
145	16-3608	Dep.; $0.75(OTS)
1007	16-3832	See IDO-19301
CERN–	**(Non-AEC)**	
61-24	16-3752	Dep.(mc)
CISE–	**(Italian)**	
R-44	16-3942	See NDA-2132-6
CM–	**(Misc.)**	
991*	16-3378	See AD-257717
CREL–	**(Canadian)**	
944	16-3381	Dep.; $1.00(AECL)
CRFD–	**(Canadian)**	
1011	16-3817	Dep.; $1.00(AECL)
CTSL–		
26	16-3644	Phys. Rev. 124: 953-64(1961)
CU–	**(Misc.)**	
9-61-SC-78330-Phys.*	16-3535	See NP-11112
CVNA–	**(Misc.)**	
27(Pt.B, Vol.II)*	16-3258	Dep.(mc); $14.00(fs), $6.44(mf) OTS
72	16-3939	Dep.(mc); $15.00(fs), $6.95(mf) OTS
DMIC–	**(Non-AEC)**	
161	16-3420	OTS
DMIC-Memo–	**(Non-AEC)**	
139	16-3452	OTS
DP–		
646	16-3062	Dep.; $0.50(OTS)
649	16-3095	Dep.; $0.50(OTS)
DPC-PCA–	**(French)**	
61-83	16-2993	See NP-10967
DPR-INF–	**(British)**	
264	16-3259	Dep.(mc)
EANDC(E)–	**(German)**	
21	16-3666	Dep.(mc)
ER–	**(Misc.)**	
4106	16-3970	See NAA-SR-6300
4442	16-3971	See NAA-SR-6301
4443	16-3973	See NAA-SR-6303
4472	16-3972	See NAA-SR-6302
EURAEC–		
169	16-3450	See BMI-X-178
EXP-NRX–	**(Canadian)**	
1104	16-3817	See CRFD-1011
FTD-TT–	**(Non-AEC)**	
61-72	16-3359	
61-94	16-3541	OTS
61-151	16-3948	
61-160	16-3482	
GA–	**(Misc.)**	
2344	16-3763	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2385	16-3818	Dep.(mc); $2.60(fs), $1.07(mf) OTS
2438	16-3667	Dep.(mc); $2.60(fs), $0.98(mf) OTS
2503	16-3656	Dep.; $2.00(OTS)
GAMD–	**(Misc.)**	
2363	16-3396	Dep.(mc); $1.60(fs), $0.80(mf) OTS
GEAP–	**(Misc.)**	
3729*	16-3406	
3739	16-3819	Dep.; $2.00(OTS)
3764	16-3820	Dep.; $0.50(OTS)
3781	16-3940	Dep.; $1.25(OTS)
GNEC–		
190	16-3941	Dep.; $2.75(OTS)
HW–		
52347	16-3821	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60611	16-3453	Dep.(mc); $1.10(fs), $0.80(mf) OTS
61989	16-3822	Dep.(mc); $1.10(fs), $0.80(mf) OTS
63411	16-3382	$2.60(fs), $0.98(mf) OTS
64452	16-3237	Dep.; $1.50(OTS)
64561	16-3823	Dep.; $1.75(OTS)
67938	16-3421	Dep.(mc); $2.60(fs), $1.01(mf) OTS
68081	16-3260	Dep.(mc); $5.60(fs), $1.97(mf) OTS
68183	16-3824	Dep.(mc); $2.60(fs), $0.86(mf) OTS
68198	16-3825	Dep.(mc); $2.60(fs), $0.89(mf) OTS
68253	16-3454	Dep.; $1.25(OTS)
68858	16-3383	Dep.(mc); $1.10(fs), $0.80(mf) OTS
69292(Rev.)	16-3241	Dep.; $0.50(OTS)
69587(Rev.)	16-3261	Dep.(mc); $1.60(fs), $0.80(mf) OTS
69627	16-3979	Dep.; $0.50(OTS)
69678	16-3455	Dep.; $1.00(OTS)
69679	16-3422	Dep.; $1.50(OTS)
69882	16-3168	$5.60(fs), $1.76(mf) OTS
70453	16-3826	Dep.; $1.60(fs), $0.80(mf) OTS
70527	16-3140	p.244-52 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961
70612	16-3456	Dep.; $1.60(fs), $0.80(mf) OTS
HW-SA–		
1948	16-2947	J. Inorg. & Nuclear Chem. 20: 131-9(1961)
2172	16-3271	See TID-7615(p.65-77)
2173	16-3270	See TID-7615(p.57-64)
2226	16-3133	p.206-12 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961

Report No.	Abstract No.	Availability
2228	16-3148	p.317-20 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961
IBM–	**(Non-AEC)**	
61-521-10	16-3521	
IDO–		
14562	16-3063	Dep.; $0.75(OTS)
16029	16-3827	Dep.(mc); $1.10(fs), $0.80(mf) OTS
16607	16-3828	Dep.; $2.00(OTS)
16712	16-3829	Dep.; $0.75(OTS)
16721	16-3830	Dep.; $2.50(OTS)
16722	16-3831	Dep.; $0.50(OTS)
16732	16-3064	Dep.; $0.50(OTS)
19301	16-3832	$19.75(fs), $9.36(mf) OTS
IS–		
243	16-3699	Nuclear Phys. 27: 234-47(1961)
342	16-2991	Dep.; $3.50(OTS)
372	16-3575	Phys. Rev. Letters 7: 363-5(1961)
374	16-2992	Dep.; $0.50(OTS)
376	16-2963	Dep.; $1.50(OTS)
JAERI–	**(Japanese)**	
5002(2)	16-3196	For English translation see NP-tr-815
6003	16-3955	
6008	16-3262	Dep.(mc)
JPRS–	**(Non-AEC)**	
8937	16-3542	OTS
9706	16-3278	$2.25(OTS)
10418	16-3247	Dep.(mc); OTS
10599	16-3293	OTS
10833	16-3195	OTS
10879	16-2851	OTS
KAPL–		
2172	16-3609	Dep.; $0.75(OTS)
KAPL-M–		
BED-4	16-3407	Dep.(mc); $1.60(fs), $0.80(mf) OTS
GLB-6	16-3384	Dep.(mc); $1.60(fs), $0.80(mf) OTS
JJS-3	16-3610	Dep.(mc); $2.60(fs), $1.04(mf) OTS
NCF-3	16-3385	Dep.(mc); $1.10(fs), $0.80(mf) OTS
SAT-7	16-3423	Dep.(mc); $1.10(fs), $0.80(mf) OTS
KL–		
1188	16-3101	See TID-14183
LA–		
2621	16-3424	Dep.; $1.00(OTS)
LAMS–		
2532(Vol.I)	16-2814	Dep.; $4.00(OTS)
2612	16-3425	Dep.; $1.00(OTS)
LMSD–	**(Non-AEC)**	
894830	16-3764	
MATT–		
78	16-3786	Phys. Fluids 4: 1448-9(1961)
88	16-3782	Phys. Fluids 4: 1407-11(1961)
99	16-3457	Dep.; $1.50(OTS)
MCW–		
1469	16-3065	Dep.; $1.00(OTS)
MGCR-M–		
347	16-3396	See GAMD-2363
ML–	**(Misc.)**	
863*	16-3596	
MLM–		
1117	16-2926	Dep.; $1.60(fs), $0.80(mf) OTS
MND-E–	**(Misc.)**	
2418*	16-3833	
MND-P–		
2291	16-3965	Dep.(mc); $4.60(fs), $1.43(mf) OTS
2483-2	16-3966	Dep.(mc); $10.50(fs), $4.25(mf) OTS
2483-3	16-3967	Dep.(mc); $4.60(fs), $1.52(mf) OTS
2581-I	16-3306	Dep.(mc); $4.00(OTS)
3014-I	16-3968	$7.60(fs), $2.36(mf) OTS
3015-III	16-3969	Dep.(mc); $6.60(fs), $2.06(mf) OTS
MR-N–	**(Non-AEC)**	
286	16-3657	See NARF-61-33T
288	16-3031	See NARF-61-37T
NAA-SR–		
6300	16-3970	Dep.(mc); $6.60(fs), $2.03(mf) OTS
6301	16-3971	Dep.(mc); $7.60(fs), $2.33(mf) OTS
6302	16-3972	Dep.(mc); $5.60(fs), $1.88(mf) OTS
6303	16-3973	Dep.(mc); $9.60(fs), $3.56(mf) OTS
NARF–	**(Non-AEC)**	
61-33T	16-3657	
61-37T	16-3031	
NASA-TN–	**(Misc.)**	
D-1102*	16-3611	$1.25(OTS)
NAVDOCKS-TP–		**(Non-AEC)**
PL-8	16-3263	
NCRP–	**(Non-AEC)**	
25	16-3227	$0.35(GPO)
NDA–	**(Misc.)**	
2132-6	16-3942	Dep.; $1.50(OTS)
NDL-TR–	**(Non-AEC)**	
6	16-3799	
9	16-3181	
11	16-3821	
12	16-3834	
NMI–	**(Misc.)**	
1246	16-3835	Dep.; $2.00(OTS)
NOR–	**(Non-AEC)**	
61-26	16-3765	
NP–	**(AEC File No. for Non-AEC Reports)**	
10709	16-3532	Dep.(mc)
10713	16-2913	
10927	16-3911	
10959	16-3533	
10961	16-3974	
10963	16-2912	
10967	16-2993	
10984	16-3397	
11035	16-3975	
11055	16-3458	
11062	16-2914	
11065	16-2844	
11067	16-2845	
11068	16-2846	
11069	16-3459	
11070	16-3766	Dep.(mc)
11072	16-3426	
11081	16-3032	
11082	16-2847	
11083	16-2848	
11091	16-3534	
11105	16-3980	
11106	16-3658	Dep.(mc)
11107	16-3956	Dep.(mc)
11108	16-3460	
11109	16-3976	
11112	16-3535	
11114	16-2849	
11119	16-3408	
11121	16-3522	
11124	16-3427	
11125	16-3461	
NP-tr–	**(AEC File No. for Non-AEC Translations)**	
808	16-2997	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
812	16-2932	Dep.(mc); $1.60(fs), $0.80(mf) JCL
815	16-3196	Dep.(mc); $1.10(fs), $0.80(mf) JCL
817	16-3372	
818	16-3294	Dep.(mc); $1.60(fs), $0.80(mf) JCL
NRC–	**(Canadian)**	
6533	16-3625	Can. J. Phys. 39: 730-2(1961)
NYO–		
7864	16-3668	Dep.(mc); $3.60(fs), $1.16(mf) OTS

Report No.	Abstract No.	Availability
9535	16-3801	$1.10(fs), $0.80(mf) OTS
9645	16-3096	Dep.; $1.25(OTS)
9725	16-3428	Dep.; $3.00(OTS)
9747	16-3638	Phys. Rev. 124: 890-6(1961)
ORINS–		
40	16-3183	Dep.; $1.50(OTS)
ORNL–		
3065	16-3066	Dep.; $0.50(OTS)
3157	16-3943	Dep.; $3.50(OTS)
3186	16-3067	Dep.; $1.00(OTS)
3193	16-3836	Dep.; $4.50(OTS)
3197	16-3097	Dep.; $1.60(fs), $0.80(mf) OTS
3217	16-3098	Dep.; $2.60(fs), $1.04(mf) OTS
3218	16-3890	Dep.; $0.75(OTS)
3228	16-3068	Dep.; $0.50(OTS)
ORNL-TM–		
44	16-3957	Dep.(mc); $1.60(fs), $0.80(mf) OTS
52	16-3891	Dep.(mc); $2.60(fs), $0.98(mf) OTS
63	16-3099	Dep.(mc); $1.10(fs), $0.80(mf) OTS
68	16-3892	Dep.(mc); $4.60(fs), $1.67(mf) OTS
ORO–		
461	16-3462	Dep.; $2.25(OTS)
493	16-3060	Dep.(mc); $1.10(fs), $0.80(mf) OTS
502	16-3463	Dep.(mc); $2.60(fs), $0.98(mf) OTS
PAN–	**(Polish)**	
236/V	16-3069	Dep.(mc)
245/1-B	16-3398	Dep.
PATENTS	**(British)**	**3s. 6d. each, U. K. Patent Office**
877,792	16-3437	
878,042	16-3375	
878,174	16-3230	
879,260	16-3954	
880,687	16-2855	
880,708	16-3177	
881,184	16-3514	
881,223	16-3515	
882,000	16-3913	
882,117	16-3914	
882,224	16-3915	
882,311	16-3404	
882,361	16-3916	
882,366	16-3157	
882,367	16-3158	
882,402	16-3159	
882,551	16-3087	
882,598	16-3917	
882,607	16-3376	
882,633	16-3918	
882,636	16-3919	
882,651	16-3920	
882,670	16-3921	
882,679	16-3516	
882,689	16-3922	
882,714	16-3923	
882,715	16-2955	
882,729	16-3160	
883,196	16-3924	
883,241	16-3925	
883,266	16-3055	
883,281	16-3161	
883,318	16-3162	
883,388	16-3088	
883,414	16-3163	
883,447	16-3089	
883,473	16-3056	
883,501	16-3926	
883,632	16-2989	
883,674	16-3231	
883,678	16-3927	
883,698	16-3164	
883,707	16-3796	
883,716	16-3928	
883,717	16-3929	
883,728	16-3057	
883,752	16-3930	
883,760	16-3438	
883,768	16-3058	
883,781	16-3232	
883,867	16-3304	
883,901	16-3931	
883,986	16-3932	
884,006	16-2956	
884,082	16-3233	
884,108	16-3439	
PATENTS	**(German)**	
108,0081	16-3036	For French translation see CEA-tr-A-1000
PATENTS	**(Italian)**	
349,185	16-3399	For French translation see CEA-tr-X-256
PATENTS	**(Norwegian)**	
82,254	16-3369	For French translation see CEA-tr-X-281
PATENTS	**(Spanish)**	
222,160	16-3371	For French translation see CEA-tr-X-396
PATENTS	**(U.S.S.R.)**	
124,554	16-3192	For French translation see CEA-tr-R-1236
PATENTS	**(U. S.)**	**$0.25 each, U. S. Patent Office**
3,009,869	16-3933	
3,009,881	16-3934	
3,011,865	16-3090	
3,011,923	16-3440	
3,011,962	16-3935	
3,012,139	16-3165	
3,012,210	16-3234	
3,012,811	16-3166	
3,012,848	16-3235	
3,012,849	16-3091	
3,012,955	16-3797	
3,012,956	16-3936	
3,013,859	16-3092	
3,013,909	16-2957	
3,013,953	16-3093	
3,013,978	16-2958	
3,014,154	16-3978	
3,014,857	16-3798	
3,015,031	16-3236	
PE-TR–		
5987	16-3096	See NYO-9645
PG-Report–	**(British)**	
229(2nd Ed.)	16-2964	Dep.; $0.25(BIS)
264	16-2965	Dep.; $0.21(BIS)
PIBMRI–	**(Non-AEC)**	
937-61	16-3386	
PRDC-TR–		
49	16-3944	Dep.(mc); $1.60(fs), $0.80(mf) OTS
PS-INT–	**(Non-AEC)**	
AR-59-2	16-3766	See NP-11070
PST-Cat.–	**(Non-AEC)**	
112	16-3538	See AEC-tr-3973(Pt.II and Add.)
PUC–		
1961-39	16-3808	Phys. Rev. 124: 925-35(1961)
PWA–	**(Non-AEC)**	
1940*	16-3767	
PWAC–	**(Misc.)**	
359	16-3464	Dep.; $0.75(OTS)
R–	**(Misc.)**	
61APE51*	16-3406	See GEAP-3729
61CAP9(Rev.)*	16-3238	Dep.; $0.50(AECL)
61SD089	16-3768	
RADC-TN–	**(Non-AEC)**	
61-39	16-3465	
RADC-TR–	**(Non-AEC)**	
61-77	16-3765	See NOR-61-26
61-104	16-3767	See PWA-1940

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RLI–	**(Canadian)**	
4(Rev.)	16-3893	Dep.; $1.00(AECL)
5(Rev.)	16-3409	Dep.; $1.00(AECL)
RM–	**(Misc.)**	
2776-AEC	16-3536	Dep.(mc); $4.60(fs), $1.55(mf) OTS
RMO–		
3001(Rev.1)	16-2966	Dep.; $2.00(OTS)
SAN–		
1001	16-3169	Dep.; $3.00(OTS)
SB–	**(Non-AEC)**	
406	16-3403	$0.10(OTS)
438	16-3510	$0.10(OTS)
467	16-3593	$0.10(OTS)
472	16-3394	$0.10(OTS)
473	16-3393	$0.10(OTS)
474	16-2843	$0.10(OTS)
478	16-3511	$0.10(OTS)
479	16-3512	$0.10(OTS)
SC–	**(Misc.)**	
4610(RR)	16-3264	Dep.; $0.50(OTS)
4643(M)	16-3387	Dep.; $1.50(OTS)
SCDR–		
38-61	16-3466	Dep.(mc); $1.60(fs), $0.80(mf) OTS
SCL-T–		
388	16-3390	Dep.(mc); $1.10(fs), $0.80(mf) JCL
SCNC–	**(Misc.)**	
322*	16-3429	
SCR–		
430	16-3184	Dep.; $0.50(OTS)
SEP–		
256	16-3430	Dep.; $0.75(OTS)
258	16-3431	Dep.; $0.75(OTS)
SIT-P–	**(Misc.)**	
48	16-3616	See TID-14188
SU–		
247-2	16-3170	See TID-13485
TEM–		
567	16-3242	Dep.; $0.50(OTS)
943	16-3243	Dep.; $0.50(OTS)
1097	16-3244	Dep.; $0.50(OTS)
1098	16-3245	Dep.; $0.50(OTS)
1104	16-3246	Dep.; $0.50(OTS)
TID–		
3567	16-2815	Dep.; $0.50(OTS)
3708	16-2816	Dep.; Free, Division of Technical Information Extension
4100(1st. Rev., Suppl.14)	16-3100	Dep.; Free, Division of Technical Information Extension
7602(Pt.1)(Rev.)	16-3467	Dep.; $0.75(OTS)
7615	16-3265	Dep.; $2.50(OTS)
8536	16-3945	Dep.; $2.00(OTS)
12821	16-3894	Dep.; $0.50(OTS)
13075	16-3669	Dep.; $1.50(OTS)
13226	16-3981	Dep.; $2.50(OTS)
13389	16-3946	Dep.(mc); $2.60(fs), $1.01(mf) OTS
13485	16-3170	Dep.; $1.50(OTS)
13666	16-3670	Dep.; $4.50(OTS)
13917	16-3033	Dep.(mc); $2.60(fs), $0.92(mf) OTS
14088	16-3947	Dep.(mc); $4.60(fs), $1.46(mf) OTS
14095	16-2891	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14183	16-3101	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14188	16-3616	Dep.(mc); $3.60(fs), $1.22(mf) OTS
14227	16-2927	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14229	16-3102	Dep.(mc); $7.60(fs), $2.60(mf) OTS
14241	16-3671	$1.60(fs), $0.80(mf) OTS
14259	16-2928	Dep.(mc); $11.00(fs), $4.49(mf) OTS
14281	16-2994	Dep.(mc); $3.60(fs), $1.19(mf) OTS
14283	16-2872	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14285	16-2850	Dep.(mc); $2.60(fs), $0.83(mf) OTS
14294	16-2892	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14295	16-3388	Dep.(mc); $5.60(fs), $1.73(mf) OTS
14296	16-3389	Dep.(mc); $5.60(fs), $1.76(mf) OTS
14308	16-2873	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14310	16-2967	Dep.(mc); $12.00(fs), $5.15(mf) OTS
14311	16-3473	Dep.(mc); $1.60(fs), $0.80(mf) OTS
TM–	**(Misc.)**	
3159-67*	16-3459	See NP-11069
TN–	**(Non-AEC)**	
42	16-3030	See AFOSR-1541
UCLA–		
485	16-2874	Dep.(mc); $2.60(fs), $1.01(mf) OTS
487	16-2875	Dep.(mc); $1.60(fs), $0.80(mf) OTS
491	16-2876	Dep.(mc); $1.60(fs), $0.80(mf) OTS
492	16-2877	Dep.(mc); $1.60(fs), $0.80(mf) OTS
UCOL-P–		
508	16-3753	Dep.(mc); $2.60(fs), $0.98(mf) OTS
UCRL–		
6252	16-3729	Phys. Rev. 124: 544-51(1961)
6263	16-3728	Phys. Rev. 124: 527-43(1961)
6298	16-3185	Dep.; $1.25(OTS)
6347-T	16-3602	J. Geophys. Research 66: 3671-80(1961)
6395	16-3206	J. Opt. Soc. Am. 51: 1400-1(1961)
6466	16-3636	Phys. Rev. 124: 830-2(1961)
6468-T	16-3109	p.15-21 of "Proceedings of the Ninth Conference on Hot Laboratories and Equipment, Chicago, Illinois, November 7-9, 1961." Chicago, American Nuclear Society, 1961
6505	16-3186	Dep.; $1.00(OTS)
6525-T(Rev.)	16-3537	Dep.(mc); $1.10(fs), $0.80(mf) OTS
6644-T	16-3577	Phys. Rev. Letters 7: 367-9(1961)
9578	16-3639	Phys. Rev. 124: 897-903(1961)
9660	16-3034	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9673	16-3629	Phys. Rev. 124: 575-9(1961)
9677	16-3643	Phys. Rev. 124: 947-52(1961)
9700	16-3723	Phys. Rev. 124: 354-8(1961)
9816	16-3187	Dep.; $0.50(OTS)
9834	16-3630	Phys. Rev. 124: 602-11(1961)
9842	16-2929	Dep.; $2.50(OTS)
13016	16-3171	Dep.; $1.50(OTS)
UCRL-Trans–		
525(L)	16-2933	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
717(L)	16-2838	Dep.(mc); $6.60(fs), $2.24(mf) JCL
728(L)	16-3484	$3.60(fs), $1.19(mf) JCL
729	16-3400	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
732(L)	16-3373	Dep.(mc); $1.60(fs), $0.80(mf) JCL
737	16-2878	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
739	16-3172	Dep.(mc); $1.60(fs), $0.80(mf) JCL
741	16-2934	Dep.(mc); $2.60(fs), $0.83(mf) JCL
USBM-U–	**(Misc.)**	
863	16-3474	Dep.; $0.50(OTS)
USNRDL-TR–	**(Non-AEC)**	
528	16-3672	
530	16-2817	
VDIT–	**(Swedish)**	
16.1a	16-3523	Dep.(mc)
40	16-3432	Dep.(mc)
46	16-3433	Dep.(mc)
VL–	**(Non-AEC)**	
2143-10-0	16-3528	See AFOSR-860
WADC-TR–	**(Misc.)**	
59-603(Pt.2)*	16-3475	OTS
59-744(Vol.VI)*	16-3476	OTS
WADD-TR–	**(Non-AEC)**	
59-366(Pt.3)	16-3477	OTS
60-37(Pt.2)	16-3478	OTS
60-676	16-3977	OTS
60-836	16-3769	
61-181	16-3479	OTS
61-262	16-3480	OTS
WAL-TR–	**(Non-AEC)**	
375/1	16-3481	

Report No.	Abstract No.	Availability
WAPD-T–		
1248	16-3720	Nuclear Sci. and Eng. 11: 324-7(1961)
WASH–		
1033	16-3673	Dep.; $1.25(OTS)
WT–	**(Misc.)**	
85*	16-2818	$16.50(fs), $7.94(mf) OTS
338*	16-2819	Dep.(mc); $4.60(fs), $1.55(mf) OTS
714*	16-2820	Dep.(mc); $9.60(fs), $3.59(mf) OTS
1102*	16-2821	Dep.(mc); $9.60(fs), $3.56(mf) OTS
1103*	16-2822	Dep.(mc); $2.60(fs), $1.01(mf) OTS
1105*	16-2823	Dep.(mc); $7.60(fs), $2.48(mf) OTS
1108*	16-2824	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1109*	16-2825	Dep.(mc); $13.00(fs), $5.90(mf) OTS
1110*	16-2826	Dep.(mc); $6.60(fs), $2.18(mf) OTS
1112*	16-2827	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1114*	16-2828	Dep.(mc); $8.60(fs), $2.96(mf) OTS
1124*	16-2829	Dep.(mc); $12.00(fs), $5.27(mf) OTS
1126*	16-2830	Dep.(mc); $4.60(fs), $1.64(mf) OTS
1129*	16-2831	Dep.(mc); $9.60(fs), $3.74(mf) OTS
1148*	16-2832	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1149*	16-2833	Dep.(mc); $3.60(fs), $1.40(mf) OTS
1155*	16-3188	Dep.(mc); $14.00(fs), $6.50(mf) OTS
1403*	16-2834	Dep.(mc); $10.10(fs), $4.10(mf) OTS
1404*	16-2835	Dep.(mc); $10.50(fs), $4.13(mf) OTS
1406*	16-2836	Dep.(mc); $9.10(fs), $3.26(mf) OTS
1487*	16-2837	Dep.(mc); $3.60(fs), $1.22(mf) OTS
Y–		
1363	16-3189	Dep.; $1.50(OTS)
ZPh–	**(Non-AEC)**	
096	16-3770	